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We can do without pirates!

EVERY now and again, some experimenter is prosecuted for having operated an unlicensed radio transmitter — the result of misguided zeal. The case prompts a small par. in the local paper, the offender is fined and learns the hard way not to do it again. This journal is certainly not opposed to such action, for it is part of the task of maintaining law and order in the radio frequency spectrum. In society as we know it, if law is not enforced, order rapidly disappears.

But those who are so punished must look with bewilderment on the situation in Europe, where "pirate" radio and television stations, operating from ships in international waters, openly defy the authorities in adjacent countries. In fact, there is a tendency, in some quarters, to regard them, not as pirates, but as crusaders of a kind.

It must be bewildering, also, to see the liberties which are taken with radio frequency channels in the United States. For example, "bugging" appears to be the order of the day, with operators taking pride in the number of microphones they can secrete and the distance over which the signals can be monitored. To counter these devices, citizens are now being offered anti-bugging gadgets which presumably function by lousing up the entire spectrum in the vicinity, between about 10 and 250MC.

Nor is it safe, any more, to steal somebody's brief case or luggage. A recent do-it-yourself article explains how to fit luggage with a miniature pulsed transmitter, radiating a permanent signal which can be traced with a portable receiver.

In defence of such gadgets, it may be claimed that their radiated power is low and that they bend the law, rather than break it. But they all contribute to the noise ambient of the radio frequency spectrum and they can cause positive interference with essential services.

In a recent blitz in the Los Angeles area, occasioned by severe interference with essential services above 200MC, 58 garage door-opening devices were condemned by the FCC, with trouble traceable not only to transmitters but to super-regenerative receivers which were operating 24 hours a day.

Remarks in this journal are not likely to have any influence on the position in Europe and America, but they may contribute to our conscience in the matter, in this country. Electrical interference is problem enough, without cluttering the bands further with illegal and unnecessary radio emissions.

N. V. Williams

February, 1966

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COVER PICTURE

Pictured on the cover is a group of linear analog micro-circuits, which are used in Litton inertial navigational systems. The circuits are made up from a combination of various techniques, involving thin-film resistor and capacitor materials, integrated flat-pack circuitry and selected discrete components. An article on the subject of inertial guidance appears on page 4 of this issue.

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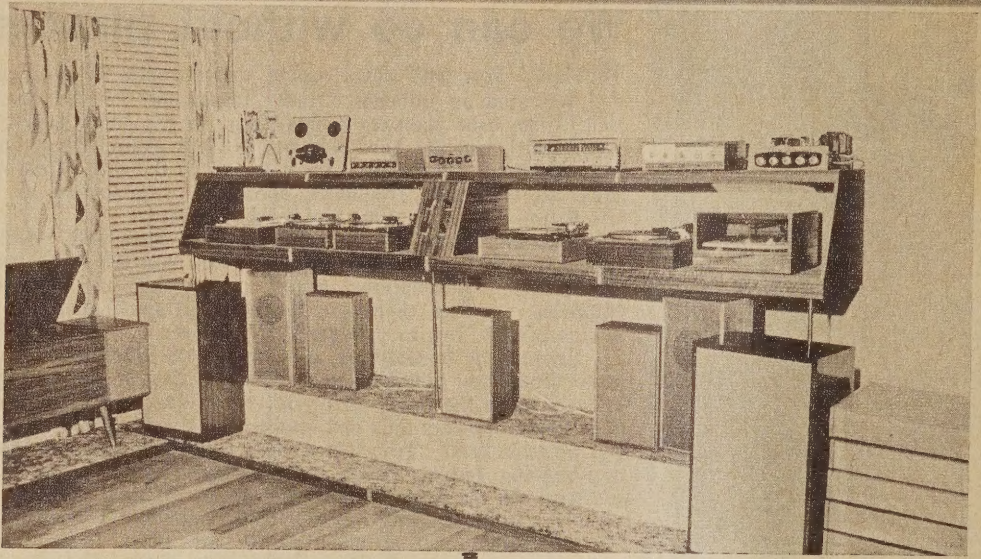

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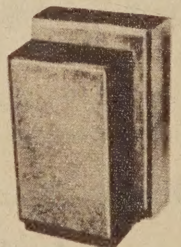

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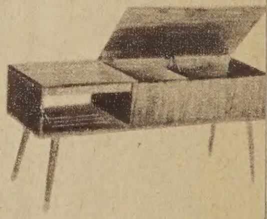

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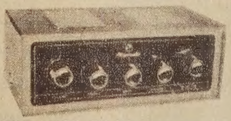

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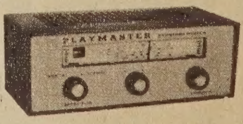

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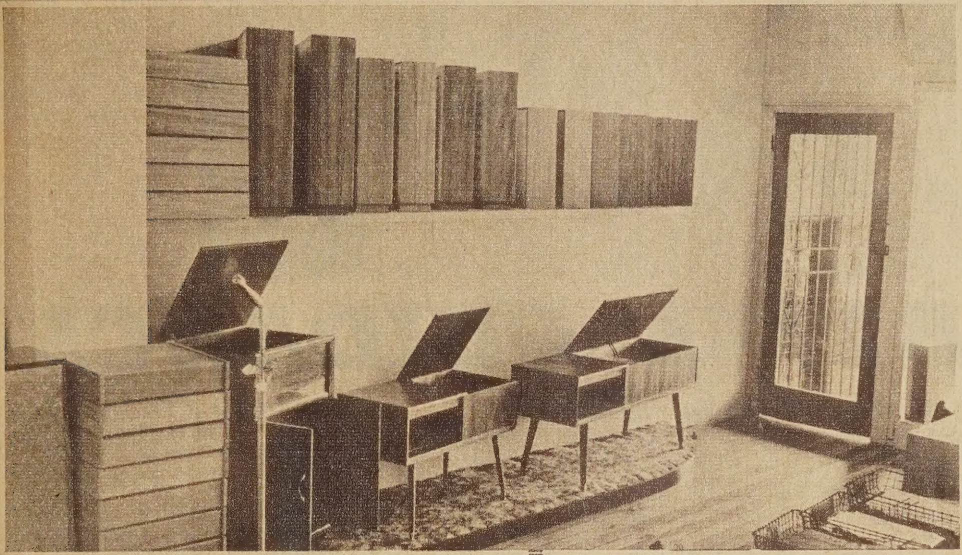

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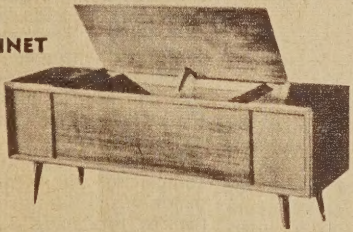

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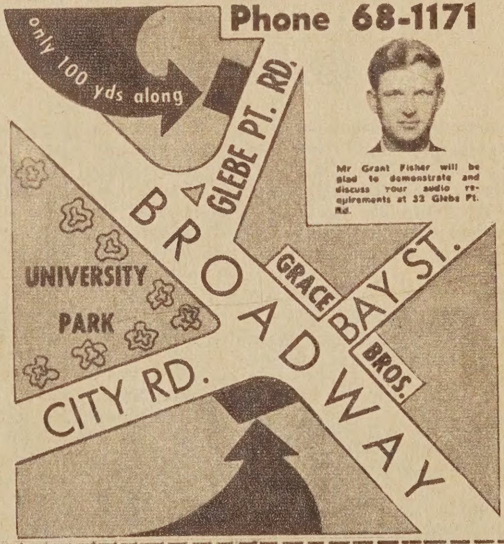

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At the large Woodland Hills Plant (California) of Litton's Guidance and Control Systems Division, workers use "palette" type boards for the assembly of harness wiring used in the production of computers for the inertial navigation systems.

INERTIAL GUIDANCE

The Royal Australian Air Force is now equipping with the P-3 Orion "submarine killer" and the General Dynamics F-111A fighter-bomber, both of which use an inertial navigation system. Qantas is also planning to evaluate the system for airline operation. This article, based on information from Litton Industries, explains the principles of inertial navigation.

By Bill Baverstock

THE fundamental principles of inertial navigation have been known since the time of Newton, but it is only in recent years that the design and development of extremely accurate sensing devices and data processing systems have enabled the principles to be put into practice.

The various systems of navigation fall into two general classifications:

(a) "Externally referenced" in which the science is practised by reference to data **outside** the vehicle being navigated and

(b) "Self-contained," which requires **no external reference** beyond the criteria which define the position of the point of departure.

Inertial navigation belongs to this latter group, being based on acceleration measurements made within the aircraft, missile, submarine or other vehicle in which it is installed. Sensitive accelerometers, held in proper orientation by precision gyroscopes and supplementary equipment, measure the "acceleration" components which indicate progressive changes in the vehicle's velocity state and direction. This information is processed continuously by electronic circuits which provide a read-out of speed at any instant, distance and direction travelled and, from this, positional information relative to the earth's surface.

Since the errors of self-contained systems tend to increase with time and distance flown, extreme precision is vital in every aspect of the data sensing and processing.

Despite the problems, however, developments in guided missiles and the increasing speed of manned aircraft have made imperative the perfection of some kind of self-contained navigation system which is, by its very nature, immune to enemy or other outside interference, independent of ground stations and unaffected by vagaries of the weather.

In fact, certain aircraft can no longer operate at peak efficiency without a self-contained automatic guidance device, the use of which now is becoming standard.

Although inertial navigation involves the use of complex electronic circuits, its basic principles are inherently simple and give it many advantages over earlier navigation systems. One of its outstanding advantages is the ability to "know" ground speed in the presence of wind and without reference to the ground at the moment of interrogation.

Navigation systems based on air speed measurements must account continually for winds aloft in order to determine the true flight path of an aircraft. This information has to be inserted manually, often before the flight begins. In contrast the inertial navigator, needing no outside information to determine its instantaneous position, accepts the effect of wind on an aircraft as just another acceleration force to be measured.

Inertial navigation does not involve radiated signals and is not susceptible to jamming by outside sources or other interference. Above all, it is not dependent on ground transmitters of any kind. These advantages have spurred development of inertial guidance over recent years and it has now reached a level where in size, weight and performance it is claimed to be more than the equal of any other automatic navigation method.

The basic measuring instrument of an inertial navigation system is the accelerometer, an instrument which measures the acceleration of the vehicle carrying it. It consists of a pendulous mass, with limited "swing" about a pivoted axis in the instrument, and having an electric pickoff which converts the swing—or tendency to swing—to an output signal.

Typically, an acceleration of the vehicle to the right would cause the pendulous mass to swing to the left, thereby producing a pick-off signal. This is passed through a high-gain amplifier, whose output operates a "torquer," which restrains movement of the pendulous mass—the system constituting a feedback or servo loop.

The very act of restraining and nulling the pendulous mass causes a current to flow through the feedback loop, which is proportional to the original accelerating force, and this current can be sampled to provide a signal for the navigational computer equipment. A pair of accelerometers, with their axes at right angles, can provide acceleration data in any direction relative to the points of the compass.

Signals from the accelerometers pass through a great deal of electronic circuitry but find their way ultimately into a two-stage integrator. The term integrator will be familiar to most with a mathematical or electronic background; it refers to a process or a device which adds up a lot of small effects to produce a resultant — or an answer — which is related to their sum.

From the starting point, when the vehicle is at rest, the accelerometers register every subsequent acceleration (or, of course, deceleration) and these data are integrated, in the first instance, to produce an output in terms of accrued vehicle velocity at any instant of time.

A second integration system combines this derived velocity information, with me, to produce an ultimate answer in erms of distance travelled.

A gyrocompass alignment system auses one level accelerometer to be ointed towards the north, another to e east and, by interconnecting them ith the integrators, the distances traveled in the north-south and east-west irections are determined. The importnce of maintaining both accelerometers n proper orientation and level in relation o the surface of the earth now becomes pparent.

Because of the way it operates, an ccelerometer cannot distinguish between ctual acceleration and the static pull of ravity so that, if tilted off level, its output will include a component of the ravity force as well as that of vehicle cceleration. Thus, to obtain a pure cceleration signal, it is necessary to hold he accelerometer **absolutely level.**

To maintain proper orientation of the ccelerometers they are mounted on an ssembly or "platform," together with yroscopes which are the sensing elements controlling its orientation. A latform controlled by gyros in this way s also referred to as the "stable element." It is mounted in gimbals which solate it from angular motions of the ircraft. Technically, the control sys-em may be described as "two identical loated two-degrees-of-freedom gyro-copes mounted one on top of the other dumb-bell fashion' with their spin axes orizontal and at a right angle to each ther."

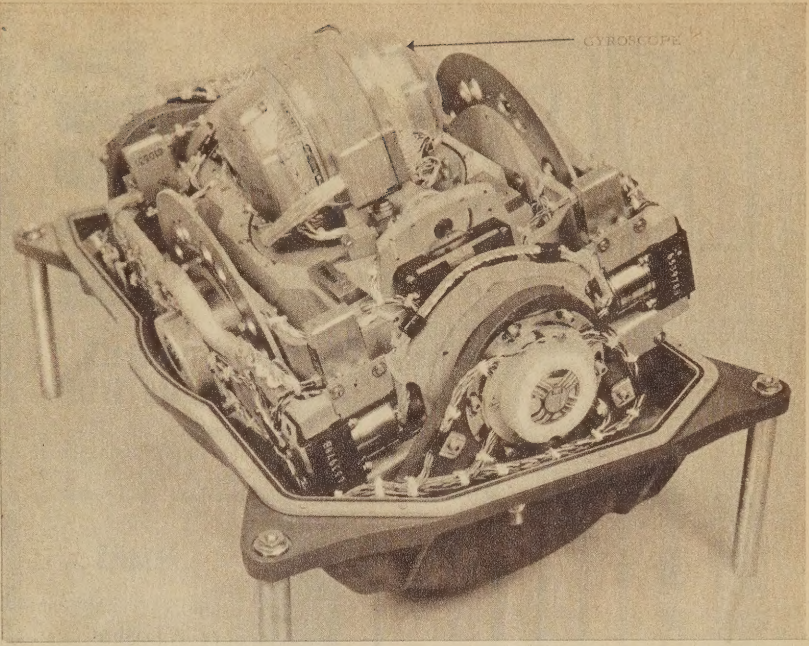
Like the familiar child's top, the wheels in these gyroscopes, which spin at igh speed, resist any effort to change heir orientation so that, once up to peed, they tend to remain in their riginal position. The gimbals in the yros are provided with pickoffs which roduce electrical signals if the gyro ase tends to move from its null position with respect to the wheels. With the yros mounted on the stable element ny displacement of it from the "frame f reference" provided by the wheels will e sensed by the pickoffs and signals rom them will drive the platform gimbals to realign the stable element.

As stated above, the stable element as complete freedom of orientation re-ardless of the manoeuvres of the air-raft. An azimuth gimbal permits the lane to change course without affecting latform orientation. A pitch gimbal nd a roll gimbal remove the effects f pitch and roll and an extra roll imbal prevents the occurrence of "gimbal lock" during manoeuvres and makes he system a truly all-attitude one.

These platform gimbals are so orien-ated that aircraft altitude and heading may be sensed by measuring angles be-ween the gimbals. Synchros transmit his information to the attitude indicator and other systems in the aircraft.

A basic navigator as outlined is cap-ble of measuring vehicle displacement over a flat non-moving earth, but an inertial navigator required to function over spherical, rotating earth involves addi-ional devices. With apparatus as simple as that described, a plane flying from he Equator to the North Pole would begin its journey with the stable element n a parallel plane to the ground, but, at the Pole, the platform—instead of being "level"—would stand 90 degrees off level.

To overcome these problems another property of the gyro is used—the property of precession. If a force is applied o an axis of a spinning gyro wheel and the wheel, through a gimbal, is free to move, it will move in a direction at right angles to the applied force. Utilising this principle, as an aircraft flies over the earth and as the earth rotates, it is possible to apply a continous torque (or force) to the appropriate axes by electromagnetic elements called torquers and so reorientate the gyro wheels to maintain the stable element level with respect to the earth below.



The P-280 stable platform fitted to the F-111A aircraft. This includes the powered gyroscopes, one visible at the top of the picture, the gimbal system, the accelerometer units mounted on the stable element, provision for gyroscope precession and the sensing system which extracts information about gyroscope and accelerometer behaviour, feeding it back into the electronic computer system.

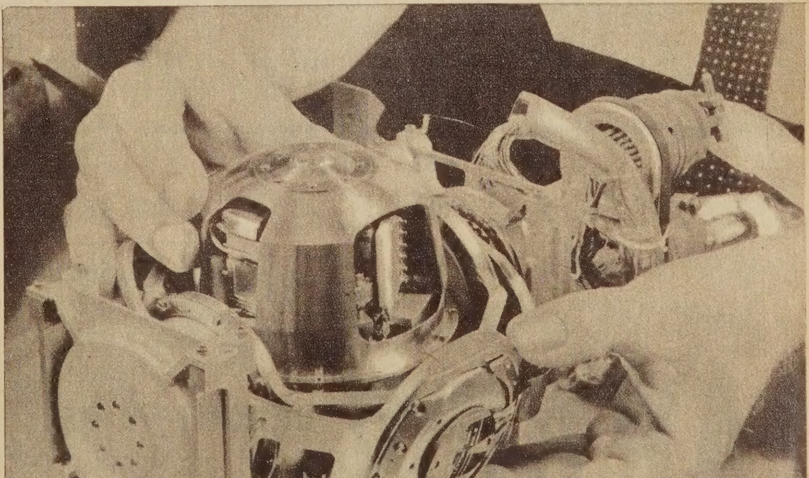
To maintain the stable element orientated to the north, torquing corrections are applied to rotate the platform around the vehicle axis to compensate for vehicle velocity.

An electronic computer is used to develop the signals necessary to torque the gyros.

The torquing necessary to maintain the stable element level as the aircraft traverses the earth's surface is referred to as "vehicle rate torquing" and involves the use of a computing loop which is said to be "schulertuned."

This is a reference to the work of

A gyroscope and its gimbal system can be seen to better advantage on this test set-up rather than in the stable platform assembly. Its size can also be readily assessed.



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mathematician Dr Maximillian Schuler published about 1923. Dr Schuler propounded the concept of a pendulum bob supported on a string of length equal to the earth's radius—about 3,440 miles; he pointed out that, no matte from where on the earth's surface such a device were suspended, the bob, if i had the opportunity, would come to res at the centre of the earth. If, at the point of suspension, a platform were arranged with its surface at right angles to the string, the platform would be level, in the usual sense of the term with respect to the earth beneath it.

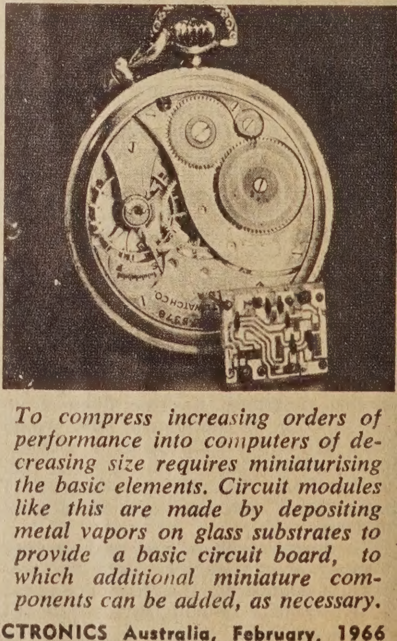
If the bob, string and platform were disturbed so that they tended to oscillate, the "assembly" would have a period of 84.4 minutes—the period of a string bob 3,440 miles long.

The inertial system's stable platform is designed so that it does, in fact, behave as if it were attached to a rigid "string" 3,440 miles long. The platform may therefore be moved anywhere over the surface of the earth and at any speed without disturbing the position of the phantom bob, at the end of the 3,440 mile line. This minimises any tendency for the platform to oscillate or "hunt." However, if it is disturbed, it has a period of 84.4 minutes, which can be used as the basis for computing any error, which the swing may introduce.

In fact, Schuler's pendulum concept represented a major contribution to the development of a modern electro-mechanical analog.

With a workable, stabilised platform it is possible accurately to measure accelerations, but two more forces now intrude — coriolis the deflecting force exerted by a rotating base (the earth) on any object moving over it and the oblateness of the earth itself—its bulge at the equator and flatness at the poles.

To understand coriolis imagine yourself at the centre of a large rotating disc trying to reach a point on its rim. Imagine, too, that the disc is composed of concentric circles and you have to jump from one to the next. It would be virtually impossible to reach your aim-point on the rim in a straight line because the rotational speed of each segment you jump from is less than that of the one at which you are aiming. To



To compress increasing orders of performance into computers of decreasing size requires miniaturising the basic elements. Circuit modules like this are made by depositing metal vapors on glass substrates to provide a basic circuit board, to which additional miniature components can be added, as necessary.

achieve anything like a straight path across the disc, each jump would have to make compensation for the rotational effect. It is this very effect which causes aeroplanes and missiles to exhibit an apparent deflection to the right in the northern hemisphere and to the left in the southern.

In inertial navigation, coriolis is cancelled by an artificially generated signal equal to and opposite of the coriolis term and this is summed with the acceleration signal.

The oblateness of the earth causes phantom accelerations in certain latitudes where the plumb line of the centre of the earth does not exactly coincide with the true vertical. The resulting platform imbalance causes a spurious acceleration indication for which the computer system provides appropriate correction.

Summarising the foregoing, an inertial guidance system involves the following:

(1) A stable element controlled in the first instance by gyroscopes but with injected information, relative to the flight in progress, to keep it precisely level with respect to the earth beneath and precisely orientated with respect to the compass points.

(2) Accelerometers mounted on the stable element, which respond to each change in velocity state referred to the compass points.

(3) An electronic system which sums all the acceleration data to produce a continuous read-out of ground speed, beginning with the original "at rest" condition.

(4) A further computing and integrating system which translates speed and elapsed time into distance travelled, making due allowance for the rotation and shape of the earth beneath.

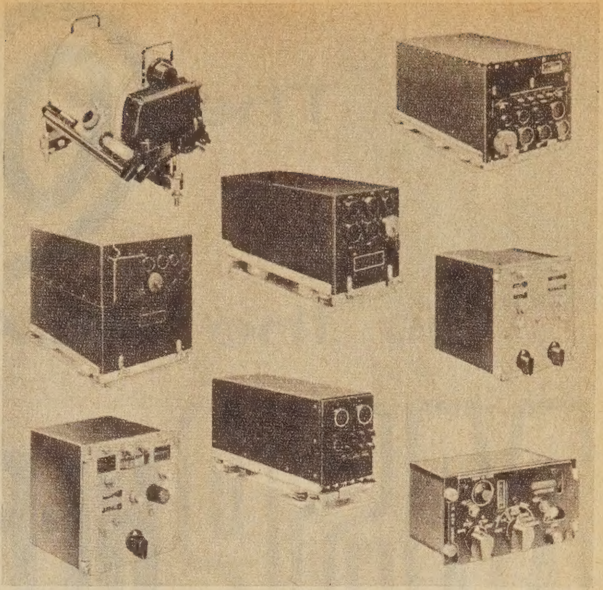
(5) The necessary computation and display to relate direction and distance travelled to the route and destination, both for information of the aircrew and to permit the aircraft to follow automatically the allotted flight path.

The first inertial guidance systems seen in Australian aviation will be those fitted to the modern frontline squadrons of Lockheed P-3A Orion and F-111A aircraft, which the R.A.A.F. has purchased. Both these systems—the LN-2C fitted to the P-3A and the LN-14A fitted to the F-111A — are products of the Guidance and Control Systems Division of Litton Industries Inc., claimed to be the world's foremost manufacturer of inertial guidance for aviation.

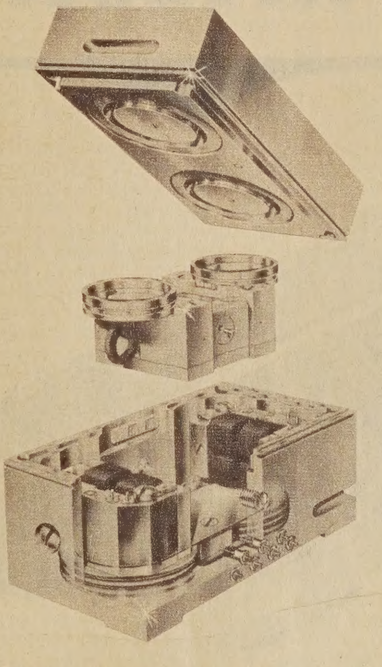
More than 3,000 aircraft throughout the free world are already fitted with Litton's inertial guidance. These aircraft include the F-104 type for the air forces of NATO countries, Nationalist China and Canada, as well as the swift F-4C McDonnell Phantom of the U.S. Air Force. In addition, Litton systems are also fitted to the Navy's Grumann aircraft of types E-1B, A-6A and E-2A.

Litton's Guidance and Control Systems Division manufactures inertial guidance equipment for these aircraft in widely separated plants, which are located in Los Angeles, Salt Lake City, Duleth (Minnesota) and Lubbock (Texas) in the U.S., Toronto, Canada, and in West Germany and Italy.

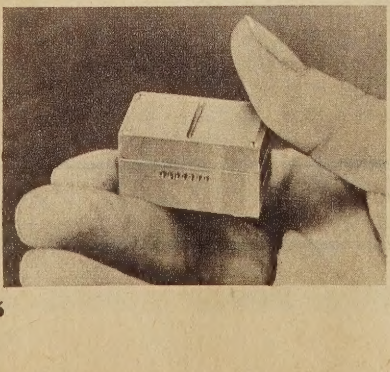
P3A ORION: The 10 Lockheed P-3A Orions on order for Australia will carry the most advanced electronic equipment to detect and destroy submarines. They will be guided by the Litton LN-2C system designed to meet the requirements of the exhaustive, long-range sweeps these aircraft make over the sea in search of enemy craft.



This photograph shows the eight components which make up the Litton LN-2C inertial navigation system on the Lockheed "Orion" P-3A aircraft; the inertial platform is in the top left hand corner of the picture. For the U.S. Navy F-111B, the system is assembled into two units, a large one containing most of the equipment and a smaller control and display unit.



Exploded view of A-200 accelerometer showing the nature of the "pendulous mass" (centre), the pivot system and the internal sensing and torquing arrangements—concepts more related to audio transducers than to physical pendulous mass. Below: Accelerometers can be very small, as this picture of the A-300 unit shows.



The LN-2C system employs the combined inertial-doppler principle which provides navigational accuracy greater than that achieved by either pure inertial or pure doppler systems. It provides a continuous and accurate determination and display of the plane's position in terms of lattitude and longitude; very accurate basic attitude reference outputs of pitch, roll and heading information throughout 360 degrees about all three axes and a continuously computed magnetic variation.

In addition to its basic function of navigation the LN-2C system is essential to the performance of other avionic equipment in the Orion.

F-111A: Due to arrive in Australia in 1968, the F-111A will be guided by the Litton LN-14A inertial navigation system. The R.A.A.F. has ordered 24 of these all-weather fighter-bombers. Recent operations in South-East Asia have re-emphasised the need for such self-contained navigation aids aboard close-support, tactical aircraft. The F-111A pilot will be able to pinpoint his target after a flight of thousands of miles without ever seeing the earth below.

The F-111A's navigation-attack system developed by Litton contains an unusual course offset feature that will enable the pilot to make an accurate bomb run on a pre-assigned target which may be hidden from the plane's radar.

Should such a target provide inadequate radar returns, the range and bearing co-ordinates of a known and observable landmark nearby, like an enemy radar installation or a water tower, can be inserted into the navigation computer either in the air or prior to takeoff. Then the computer makes trigonometrical corrections in range and bearing between the true and offset targets, automatically supplies signals to recentre the cursor on the attack radar scope and the navigation system guides the plane over the desired target. From his radar display the pilot will have the impression that he is flying over the offset target while he is actually passing over the real target. The distance separating the offset

(Continued on Page 34)

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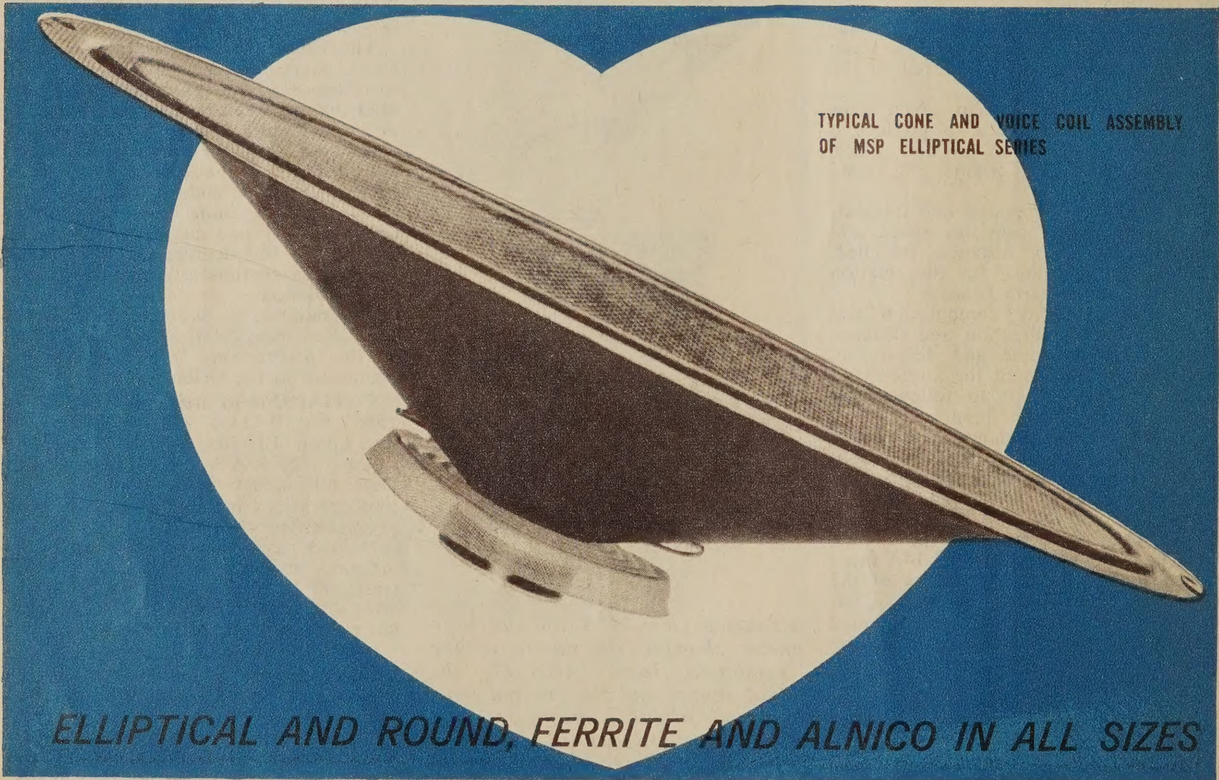

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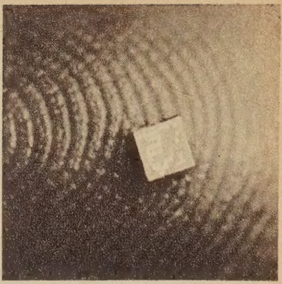
Europe's First Microcomputer

Europe's first computer range based entirely on integrated circuits has been developed by The Marconi Co. Ltd., of Chelmsford, Essex, England. Apart from the extreme miniaturisation achieved with the use of micro-circuitry, the computers have other unusual features including an "interrupt" system for priority connection, and programmed fault finding for rapid location of faulty components.



A micro-photo of one of the integrated circuits on a man's finger. It measures .02in.

THESE will be the first European machines based entirely on microelectronic techniques. They will demonstrate how normal electronic circuits, made up of separate and — however miniature — recognisable components, can be replaced by minute chips of silicon, .02in sq., holding the equivalent of dozens of conventional components. Such "integrated circuits" have now been used to build a complete, ultra-high-speed computer, able to handle massive and complex operations, which is housed mainly in one pedestal of what appears to be a handsome office desk measuring 6 x 3 x 2.75ft.

The Marconi Company Ltd. (whose computer interests were recently merged with others in the parent group to form English Electric-Leo-Marconi Computers Ltd.) claim that the computer, called "Myriad" is the most advanced process control computer commercially available in the world. At a price of between £34,000 and £65,000 sterling, it is also said to be considerably cheaper than any comparable machine. Even in its standard form it is said to compete directly in performance with many large, costly, specialised scientific computers. A team of several Myriads, with additional storage, could form a system equal in performance with the largest existing machines and with improved reliability, Marconi claim.

Myriad is the first of a family of ultra-fast digital machines for "real time" and "on line" operations. In computing terminology, this means that it can control the present-time operations of a number of processes,. while at the same time monitoring, recording, calculating and reporting on them, and will present information on demand about the up-to-the-moment state of operations.

Integrated circuits, as used in Myriad, are mainly of two kinds — monolithic and multi-chip. The first may be a complete circuit, to perform a computer logic function, diffused into a .05 inch square chip. Its diffused circuit elements are interconnected by a network of aluminium conductors, deposited according to pattern by an evaporation technique. Each circuit is alloyed to the base, 0.25 inch in diameter, of a miniature TO-5 metal can of the kind used to hold a normal transistor. Bonded gold wires connect the circuit to the eight or more plug-in pins protruding from the can.

The assembled cans are vacuum-baked at high temperature to remove all moisture, and finally sealed by welding in an atmosphere of inert gas. The resulting circuits, though minute, are far from frail. They are, in effect, tiny solid modules—impenetrable by contaminants and of low mass and able to withstand high magnitudes of shock and vibration. Each one is tested several times. While still in slice form, individual electrical evaluations are carried out under microscopic scrutiny and faulty devices eliminated. Encapsulated circuits are subjected to centrifugal forces of up to 20,000 G. Batches are put through life-testing spells in temperature-controlled rooms. Once a microelectronic circuit has passed such tests it is likely to continue fault-free indefinitely.

The multi-chip integrated circuit is produced in a similar way, except that each circuit is assembled in the cans from minute packages of separate component chips, about 0.02 inch across, and interconnected by gold wire.

Each circuit has particular advantages. The monolithic circuit's evaporated conductors are, by present standards, of unbeatable reliability. The multi-chip—used by the company for its high-speed logic modules—has better isolation between circuit components; each type of component can be made from the most favourable materials in optimum conditions; and extra, redundant component chips can be included to allow for substitution in case of failures. One multi-chip circuit may contain transistor, diode, and resistor chips with several components in each.

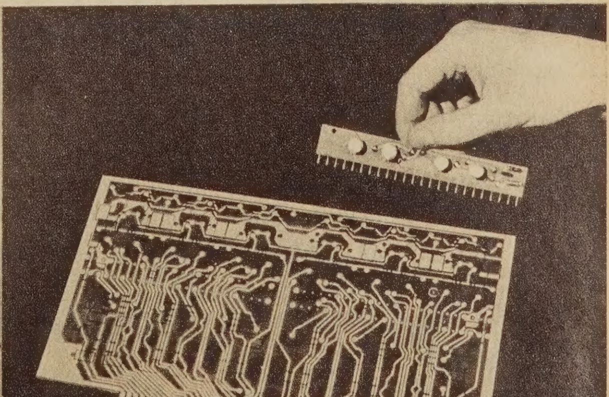
A large proportion of the central computer's most active circuits are built up from these T0-5 can units, plugged in with the minimum of ordinary wiring and connections. Modular construction builds up Myriad's logic from printed-circuit, fibreglass sub-boards, 4 inches long, each mounting four cans. Sub-boards are mounted in lots of about 20 on larger mother-boards—each specific to a particular function — with printed circuitry and edge connectors. Up to 40 of these can be slid into a case measuring only 2 x 2 x 0.75 feet. This forms the computer's entire main logic module, or calculating brain. Its standard memory is housed in two similar-sized main storage modules, with a capacity of 4,096 24-bit words, sited with the logic in one desk pedestal. The other main stores can be accommodated, if needed, in an L-shaped desk extension. The rear of the desk holds power supply equipment, including stand-by batteries to maintain operations for about three minutes during any voltage failure.

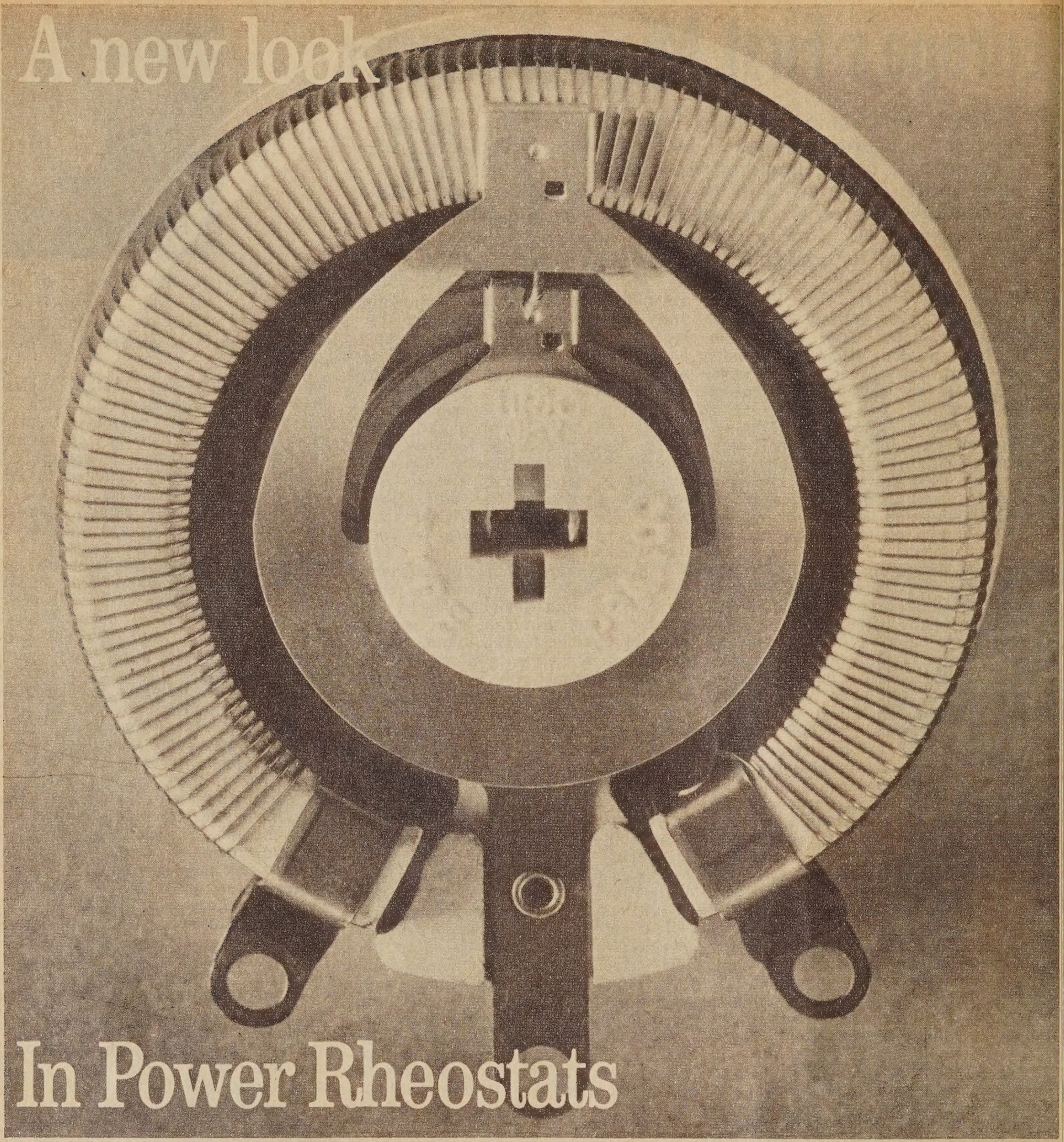
Another refinement valuable in complex operations is a high speed multi-level interrupt system. This works automatically to give access to the central

(Continued on Page 107)

The complete Myriad computer is housed in a desk measuring 6 x 3 x 2.75ft.

A main board and sub-board from the computer. Up to 20 sub-boards can be plugged into each main board.





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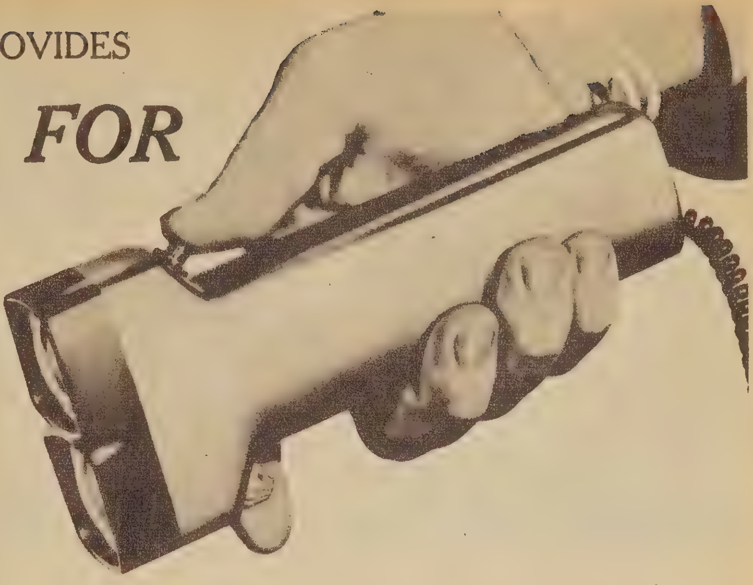

The unit has only two operating controls, a range switch (top) and on/off-volume control (below).

Organisations for the blind in 20 countries are now evaluating an ultrasonic, hand-held aid for the sightless invented and produced in Britain. It is said to be the first scientific guidance device to reach the production stage after preliminary tests and to be well in advance of anything attempted elsewhere.

by Luscombe White

MORE than 100 production-engineered units have been built by the Special Products Division of Ultra Electronics Ltd., Acton, London, W.3. St. Dunstan's (the British organisation for those blinded on war service) has bought 50, which are being put through stringent evaluation trials, and more than 80 have been ordered by overseas societies for tests by their blind members.

The aid works on the principle of detecting objects ahead by echoed ultrasonic beams. In nature, bats use the same principle to fly around obstacles. The main achievements of the aid's inventor and its developers have been to compress within the confines of a hand-held "torch" unit, only seven inches long and weighing 10 ounces, both ultrasonic transmitting and receiving heads and all their attendant electronics; and to give the aid an accurate, range-finding action through ingenious use of ultrasonic beams of a controlled varying frequency.

The result is an unobtrusive "electronic eye" (carried and wielded as a sighted man uses an electric torch) connected by leads to a small battery unit housed in a shoulder-slung case, and with an audio transducer worn like a hearing-aid. Using the equipment, a blind walker is given continuous warning of, and information about the direction, distance and nature of obstacles and reference surfaces such as walls in his path by the varied pitch, strength and "texture" of the sound presented to him.

The device owes its success to the adoption of a principle which causes the receiver to supply an audible note which rises or falls according to the distance between it and any object ahead. The transmitter sends out an ultrasonic beam which is radiated ahead in a narrow cone. The transmitted signal is made to vary in frequency in a cyclic fashion, i.e., the frequency rises and falls in a regular pattern. The companion receiver-head picks up the ultrasonic echoes from objects caught in the beam, but owing to time lag these will differ in frequency from that of the transmitted signal. This difference will always be in direct proportion to the distance of each object from the user of the equipment.

The two frequencies are continuously compared electronically and the range-significant differences translated into audible sound of varying pitch in the earpiece of the equipment. The further away the object, the higher the pitch and vice versa. Users learn to recognise this pitch-distance relationship and develop an automatic reaction which improves with practice.

By sweeping the beam horizontally, the position and approximate width of an obstacle can be judged, and a vertical movement can help to gauge its height. Independent movement of an obstacle, such as that of a walker, can be tracked and the changing signal pitch indicates whether he is approaching or receding. Objects of good sound reflectivity are detected 20 feet away and such narrow obstacles as an edge-on door or a two-inch diameter post are readily located. Stairs can be checked individually. With experience it is even possible to pick out an open manhole or an excavation in the pavement.

With experience, a blind user can negotiate even unfamiliar territory with the ultrasonic blind aid. Picture shows the unit undergoing evaluation in London.

The blind aid was invented by Dr Leslie Kay, now of Lanchester College of Technology, Coventry. Following initial tests, Ultra Electronics offered to produce a batch of 10 units for evaluation without charge.

Thorough field tests with these were carried out at St. Dunstan's Training Establishment at Ovingdean, Sussex, and at the Worcester College for Blind Boys run by the Royal National Institute for the Blind—a pioneer in mobility training. These early models were comparatively bulky and crude, with the electronics carried in a case separate from the torch. But test-results, analysed by scientists of the Medical Research Council's Applied Psychology Research Unit (which also supervised the trials), were sufficiently encouraging for St. Dunstan's to order a production-engineered batch of 50 improved aids. A full development program was started, backed by an expert working party committee.

The present unit was evolved, centreing on the compact torch containing transmitting-receiving apparatus and all the electronics. Two conveniently placed switches give on/off volume control and a free choice of long range (0-25 feet) or short range (0-7 feet). The latter can be used to cut out unwanted further echoes.

St. Dunstan's has now sponsored a three-year research program but, with minor improvements, the present model is likely to be the standard aid for some time. However, the possible use of micro-circuitry is being studied. This may lead eventually to the first blind-aid contained entirely within the framework of a pair of spectacles.

This would be as unnoticeable as the present spectacle deaf-aids, and the user would wield it merely by moving his head to "look" in any direction. This spectacular development has reached the laboratory stage and an order has been placed with the maker of the present equipment for a small batch of instruments, but much remains to be done.

ELECTRONICS AND ROAD SAFETY

By
Prof. C. J. Milner*
and
E. Laisk, M.Sc.*

Carefully planned multi-lane highways, as illustrated by this section of the Sydney-Newcastle expressway, undoubtedly make driving less irksome and contribute something to road safety. Unfortunately, this alone is not the answer. (Photo by courtesy Department of Main Roads).

Australia's annual road toll, over 3000 killed and 70,000 seriously injured, is a grim reminder that the modern motor car is, potentially, a lethal weapon. While the three "Es" — Education, Engineering, and Enforcement — may contribute something to the problem, many experts believe that a completely new approach is needed. This article, the first of two, discusses these ideas.

MANY traffic accidents are unavoidable simply because human senses and responses are neither quick enough nor have the "channel capacity" to evaluate a complex traffic situation. There may be 10-20 changes in a second in the traffic scene in the driver's field of view. He is, however, capable of only two or three observations in a second. Statistically it has been found [1] that an average driver has the following traffic probabilities:

Traffic events in view—10 or more per second.
Driver observations — 2 or more per second.
Driver decisions—1 to 3 per second.
Driver actions—30 to 120 per min.
Driver errors—at least 1 every 2 mins.
A hazardous situation—every hour or two of driving.
A near collision—once or twice a month.
A collision—every 6 years of driving.
An injury—every 40 years of driving.
A fatality—every 2,000 years of driving.

Clearly, some collisions occur because of the incompatibility of the "operational frequency" of the driver and the events in the traffic scene.

Traffic statistics further reveal that about 100,000,000,000 man-hours were spent in 1964 in motor vehicles throughout the world, and that an estimated 20 per cent of these man-hours were absolutely wasted in traffic accidents and congestions.

The world-wide cost of traffic accidents is about £5,000,000,000 a year; £100,000,000 in Australia, £250,000,000 in Great Britain. Even these huge figures cannot allow for the loss in human lives —3,000 a year in Australia alone — let alone for injuries and suffering.

What does science, especially electronics, do about it? A lot—unheralded—but the possibilities depend very much on their social acceptance. The public attitude often takes strange forms: for 2 soldiers killed in action the whole nation goes into mourning, whereas 3,000 civilians killed on the roads are mentioned only as statistics.

Similarly, there is a terrible outcry about the killing potential of an atomic bomb created by brilliant scientists; there is no such reaction to the same potential in motor cars created by brilliant technologists.

The truth is, the public wants shiny fast cars; and safety devices come as extras. Perhaps this is best shown by the slow public acceptance of seat belts, acknowledged by experts as the most effective of all present safety devices.

The fact is that traffic safety measures lag far behind their national and economic importance. There have been many conferences, symposia, and parliamentary inquiries on traffic safety. One was held here in the Australian Senate in 1960; there is one in process at present in U.S.A., conducted by a Sub-Committee of the Committee on Government Operations in Washington.

In every instance, an urgent need for radical traffic measures has been declared, but action on anything like the necessary scale has not yet resulted.

It seems that the "vehicle population explosion" has caught the planning and research institutions and the manufacturers unawares.

It is obvious that only a scientific approach can abate road accidents and traffic congestion. As a result a wide field of vigorous research in traffic safety has emerged in supermotorised countries, especially in U.S.A., U.K., West Germany and, more recently, in Australia. The Organisation for Economic Co-operation and Development (i.e. among NATO countries) has published an "International Directory of Road Safety Research" with some 120 entries.

In U.K., the Road Research Laboratory, in Crowthorne, Berkshire, employs over 750 persons, mainly in two divisions: one dealing with materials and construction, the other with traffic and safety. Their work is well known all over the world by their research reports and by two comprehensive books: "Research on Road Safety" (1963) and "Research on Road Traffic" (1965) (H.M.S.O., London).

In the Traffic and Safety Division, among many other studies, much experimental work is carried out on electronic aids for road vehicles; in particular, on electronic guidance, vehicle detection, and roadside-to-driver communication, as further discussed later.

The U.S.A., with over 50 million motor vehicles, has many research centres. The Institute of Transportation and Traffic Engineering in the University of California is particularly noteworthy. Advanced work is carried out in the Ohio State University on electronic highways, automatic vehicles guidance, an anti-rear-end-collision device, a closed-circuit-TV driving simulator, human factors research, and mathematical models of traffic flow. Research in electronic safety devices is also carried out in many university laboratories, for instance, Michigan State, Wane State, Cornell, North Western.

However, in the U.S.A., a large amount of research and advanced design work is also undertaken in the scientific research laboratories of the car

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*** School of Physics
University of N.S.W.**

manufacturers and associated electronic manufacturing companies such as Ford, General Motors, Chrysler, Radio Corporation of America, Delco, Bendix.

Ford Research Laboratory at Dearborn has been studying radar for vehicles, etc.[1] The Ford Company has a Traffic Safety Division, pursuing driver performance, traffic safety and car crash studies.

General Motors Research Laboratories at Warren are also well known for their electronic vehicle control systems, highway communication systems and a number of electronic safety devices and simulators.

Perhaps the RCA David Sarnoff Research Centre in Princeton is best known for its director, Dr V. K. Zworykin; and under his guidance a practical "Electronic Highway" system (electronic vehicle control) has been pioneered.

In Australia, road safety research is a concern of the Australian Road Research Board. Some work for the ARRB is carried out at the Universities of Adelaide and Melbourne, and at the Institute of Highway and Traffic Research of the University of New South Wales. Also at this university, the Vehicle Physics research group of the School of Physics led by one of the co-authors of this article (C.J.M.) is mainly engaged in vehicle anticollision research using radar techniques (and also in studies relating to road-tyre friction).

A long-term goal of this group is to develop an automatic vehicle guidance system somewhat analogous to the U.K. "Autoflare" automatic (blind) landing system which was recently approved[2] by the Air Registration Board in England.

There is a sense of urgency now about electronic guidance and safety devices for cars. Sir William Glanville, until this year the Director of the U.K. Road Research Laboratory, says[3] that the rapid technical progress of electronics in the past 20 years will have a great impact on road transport; the control of vehicles and traffic being obvious fields of application.

The introduction of "traffic lights" some 40 years ago began this trend. These are now mostly controlled through electronics; by time, by vehicle and pedestrian-actuated switches on the road, by supervisors using TV[4], by a city-wide computer. Their outstanding characteristic is their ability, by comparison with other traffic-control devices, to command obedience from drivers. (No other inanimate device is even remotely comparable with the uniformed police officer in this respect!) These, however, and traffic-control measures generally, have merit chiefly in promoting the efficiency of road traffic, rather than safety on the roads, on which this article will concentrate.

Electronic contributions to the operation of vehicles — here called "vehicle electronics" — can take various forms. Car radio, i.e. broadcast receivers and (rear-seat only!) TV receivers as pastimes, and radiotelephones for two-way communication with the vehicle, is an obvious one. Both in normal peak-hour and in emergency situations, broadcast messages and advice to such vehicles can, and undoubtedly do, help traffic efficiency: but electronic communications (whether by radio or other means), in order to contribute to road safety, must reach every vehicle and not only those few that are listening.

Such communication means, often called picturesquely the "Talking Road-Sign," form a distinct element in the concept widely spoken of as the "Electronic Highway." According to this concept, a busy, fast road is to be fitted with an assortment of equipment for vehicle guidance, control, and communication by electronic means; and vehicles using the highway are enabled to co-operate by themselves being fitted with (a minimum of) electronic apparatus.

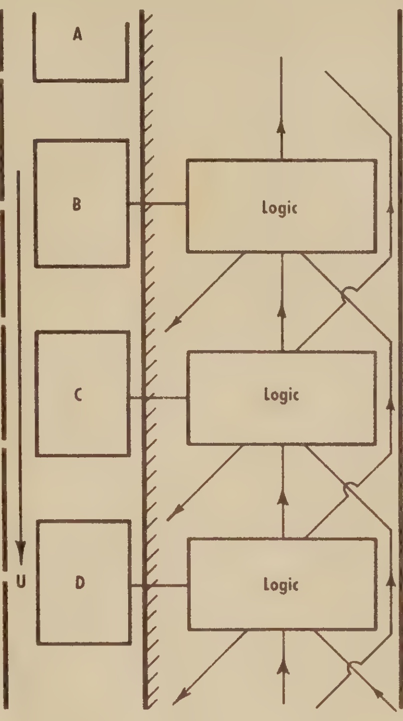


Figure 2. The blocks, A, B, C, D, are buried loops in a highway lane. Each is connected to a "logic" module, which registers the presence or absence of a vehicle, and signals the preceding modules accordingly. Each module transmits to the vehicle in its block a "red," "yellow" "green" signal, for either visual display or direct application to an automatic control system.

A non-electronic highway already has smooth carriageways, a median strip, with an anti-glare shield, easy grades and curves, clear verges, clover-leaf intersections, etc., all of which features contribute substantially to safety. Such roads both permit twice the speed, and provide three times the safety (vehicle-miles per accident), of normal roads. The Electronic Highway aims to improve on this. The first steps in this direction were taken at the RCA laboratories under Dr V. K. Zworykin.[5]

Fog is a road hazard common in many countries, and at present nightmare conditions prevail on the U.K. motorways when fog descends. Day or night, speeds of 60 or 70mph, are commonly maintained in spite of visibility falling to 50 or 100ft. Under these conditions, multiple collisions are inevitable, and they often occur. A first contribution of electronics to highway safety would be to provide information, equivalent to a clear view of objects ahead on the road, to a driver deprived of vision.

Such guidance and warning information, valuable to a driver in fog, is equally valuable if his attentiveness fails, as is likely when highway conditions allow him to relax his vigilance. A slippery path therefore leads from the philosophy of guidance and warning for drivers to the philosophy of automatic control for vehicles.

Most researchers concerned with electronic-highway developments are not quite sure where they stand on this path — the better the guidance and warning signals they can provide, the more relaxed and inattentive can the driver become; and so, the slower, the less reliable, his responses to those signals. Is there a point of stability on the path at which one can stop short of the adoption of automation? The present authors' view is that there is not: Sooner rather than later, fully automatic electronic highways will be adopted. This view arises as discussed below from a critical survey of electronic-highway and related work which one of us (C.J.M.)

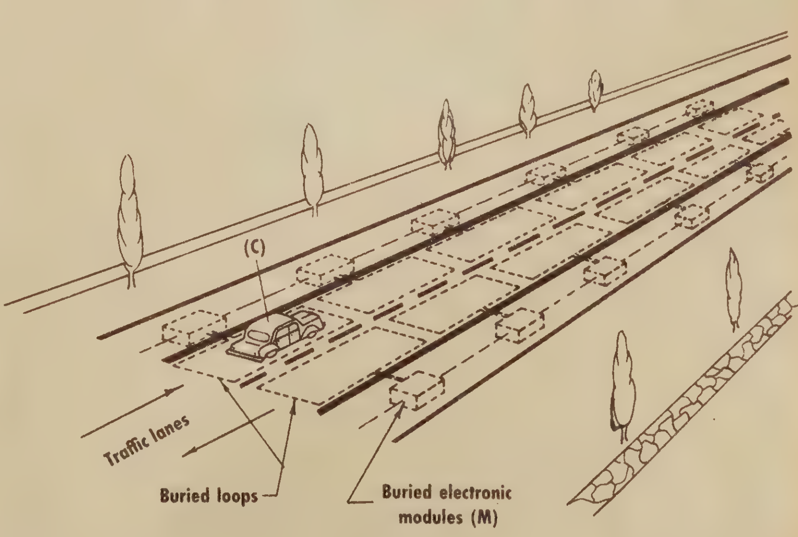


Figure 1. The physical layout of an electronic highway (not to scale) which many research workers believe will be the highway of the future. Its main aim is to maintain a safe distance between all vehicles at all times.

was able to make in U.K. and U.S.A. in early 1965.

An electronic highway must at least indicate to each driver whether he is "keeping in lane" or not, i.e., must give guidance signals showing how to steer so as to follow a marked line on the road. By different electronic techniques, different kinds of lines can be followed, including (except when under snow) the cheap painted "white lines" already in general use. Because of the relatively simple units needed on the cars, its permanence, and because it can also be used in a "Talking Road Sign" scheme, most workers favour a cable buried in the road or mounted at the roadside, AC in the cable inducing voltages in coils on the car.

Fully automatic guidance is now an established technique. Notably C. G. Giles[6] has described earlier the automatic steering of a car on a figure eight shaped track, some two miles in perimeter, at the Road Research Laboratory, Crowthorne, U.K., where one of us (C.J.M.) was privileged to work in 1965 as a visiting Research Fellow.

In industrial circles, this form of guidance is already well established and its reliability proven. The E.M.I. Robotug system using this principle was described in the December, 1965, issue of "ELECTRONICS Australia."

It is equally necessary for an electronic highway system at least to signal in some way the spacing between vehicles, so that each maintains a safe spacing from the next in front. This may be done by range-finding devices of radar or other type with which each vehicle observes another (discussed later) but most workers have favoured electronic ground-based equipment. This may comprise a series of vehicle-presence detectors ("VE-DET") laid out as in figure 1. The figure-8 track at RRL, already mentioned, is equipped with about 1,000 such buried loops for research on spacing control.

Signals from such presence detectors must be combined with one another, and the results analysed by computing devices, to acquire the spacing between vehicles. While the spacing itself may be what is signalled to each vehicle, it is almost certainly preferable to compute, on the ground, the spacing error or difference between the actual spacing of two vehicles and the safe spacing, and to transmit to each car only an error signal. The error signal would indicate braking, or directly control the brake. (In an automatic system, one may suppose the throttle to be under control of a governor that maintains a preset road speed until over-ridden by the spacing controller.)

Figure 2 suggests and describes one possible logic system for the interconnection of Ve-Det's so as to provide appropriate signals to a succession of vehicles and thereby to ensure that each follows another with a spacing that is at least equal to the safe spacing. It has been suggested elsewhere that such signalling (to human drivers) might be by display of a red, yellow or green light, in the road surface or overhead adjacent to each sensor unit. The driver is instructed to act in accordance with the light signal nearest to him at each moment.

Present research is concerned not so much with the principles for computing spacing, as with the principles that determine whether the spacing is safe or not. Even the list of factors on which this depends is not as yet determined; but it certainly includes the ground speeds of both cars, the maximum retardation available by braking without skidding, and the response time of the driver and/or control system. Each of these data must be available to the computer continuously.

Spacings that are recommended and that are adopted by responsible drivers as minimum safe values would be seriously inadequate for safety were the human drivers to act only in accordance with the electronic-highway signals as above. One may be advised to follow a car, at 60 m.p.h. say, at not less than six car-lengths, i.e., 90 to 100ft. But if the car in front "stops dead," one cannot then evade collision by "stopping short," but only by "steering clear" — and that is exactly what one instinctively tries to do. (Usually one succeeds in doing so without colliding with a third object.)

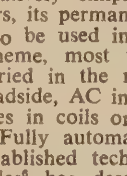
However, "steer clear" is not a signal in the language of the electronic-highway as described: this system can only ensure safety, therefore, by setting a higher standard for minimum spacing (in the example, about 200ft instead of 100ft), or by adopting an automatic vehicle-control system that bypasses the sluggish human driver — who takes most of 1 second to act on a signal even if ideally attentive.

In this way one sees that an automatic electronic highway might be made equal both in safety and in capacity to the same highway with human drivers.

Present-day thinking envisages in detail no more than the least complex electronic-highway discussed above, in which steering and spacing controls together enable cars to proceed safely, strictly

(Continued on Page 126)

They say . . .



Mr W. W. D. Harrison, Secretary, Road Safety Council of N.S.W.

"Progress in traffic accident prevention in past years has been achieved by doing many obvious things; and commonsense has provided suitable answers to the fairly simple questions.

"Today the rate of improvement in traffic accident experience is diminishing. It is no longer easy for legislators, administrators and designers to judge whether proposed new action will have much or any effect on traffic accidents.

"Continued progress in accident reduction, therefore, calls for a great deal more and better research. Otherwise we will find ourselves reaching a point where new technology will not be available to cope with the ever advancing complexity of the traffic problem.

"I believe that the work by Mr Elmar Laisk and Professor Milner in the field of vehicle electronics for road safety is an outstanding example of progressive research and farsightedness in the development of means for tackling the human factor in road accidents.

"The notion that there is an 'irreducible minimum' death and injury rate below which no improvement is possible is based on the premise that the human being will for one reason or another fail at one time or another under the stress of modern traffic conditions and, therefore, that the level of this incidence (whatever it might be) is inconvertible.

"Vehicle electronics for road safety, in my view, offers an exciting ray of hope for the future in meeting the problem of human frailty."

Dennis Gabor, F.R.S., Physicist, engineer and inventor, Professor of Applied Electron Physics at the Imperial College of Science and Technology, University of London, Department of Electrical Engineering.

"The average driver can expect a collision every six years of driving, an injury every 40 years, a fatality every 2,000 years. These figures are not sufficiently frightening to deter the average fool from taking risks, but they are more than sufficient for any responsible government to take energetic steps. If the taxpayer is willing to spend money on his car (in some countries it is said that the petrol tax is the only one which is paid willingly), he must be also ready to foot the heavy bill for his own protection.

"This excellent comprehensive survey of the problem of road safety leaves no doubt that the bill will be a heavy one, but so is the cost of traffic accidents. The cost in Britain is the frightening sum of £250 million, more than £30 per head per motorist. From a purely financial point of view it would be perfectly justifiable to spend £125 million per year if the rate of accidents can thereby be reduced to one-half. But as human life and limbs are involved, and not just material damage, for my part, I should consider £250 million as well spent if it achieves this aim.

"The most perfect solution to the problem is the Electronic Highway. The authors take a determined stand in this matter; they contend that one cannot stop short of complete automation. This, in all probability, will take the dangers out of motoring, but also the fun.

"Alice Glaser, in a brilliant science fiction story, has given us a picture of the highway between New York and the seaside in the next century, where automatic controls MUST be used. But in the same story she describes also the scene on the beach, where people, by their conditioning in an overcrowded world, stand rather than sit, while laying down is gross misbehaviour, and on the way back they are thinned out by an automatic asphyxiating tunnel, operated on strict Poisson-probabilistic lines. Thus motoring with one's own nervous system is not the only fun which will have to vanish if our civilisation follows its present insensate course.

"In the highly industrialised countries we shall come up against the danger of over-population of cars sooner than against the danger of too many human beings. Let us take one at a time, and follow the sound advice contained in this paper."

(**Editor's note:** Among the many achievements of Dennis Gabor, his research on holography is particularly interesting at the present time. An article elsewhere in this issue (Page 17) tells of his contribution to this new and extremely promising development in optical science.)

THE LUX SQ11 . . . AUSTRALIA'S MOST POPULAR SOLID STATE STEREO AMPLIFIER

Users everywhere report excellent performance with this fully transistorised stereo amplifier. Input sensitivity is 4mV, output is 20 watts in each channel. Features include: Loudness control, scratch and rumble filters, separate bass and treble controls, etc. Send for full details. Similar quality is usually twice this price! .. **$139**

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Illustrated is the Mk. III bass unit which has become very popular since Encel Electronics reduced the price! (Previously £35/10/!) Performance is excellent, even in a 3 cu. ft. enclosure. Price:

$39

The Kelly Mk. II Ribbon tweeter is complementary to the Mk. III. This is regarded as the most effective domestic tweeter ever designed, regardless of price. Encel price: $39. Crossover network to match, $11.

$39

KELLY 15" WOOFER UNIT

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KEF SPEAKERS

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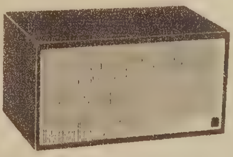

THE NEW CELESTION "DITTON 10"

Regarded as one of the most advanced compact speaker systems ever to be released, the Celestion Ditton 10 is available in either teak or walnut oiled finishes. Frequency response is conservatively quoted at 35-15,000 c/s. See the reviews in "Electronics Australia," p. 131, Dec. 65; "Hi-Fi News," p. 433, Oct. 65; "Gramophone," p. 41, June 65 Size of the Ditton is only 12¾in x 6¾in x 8¼in. Encel Price ... **$59**

Celestion

Both Celestion models are in great demand . . . and represent real value for money. The Standard Model, CX1512, has a frequency response of 30-15,000 C/s and is rated at 15 watts RMS. Both models are co-axial and employ pressure-type tweeters. Crossover frequency is 4 kc/s. The De Luxe Model, CX2012 (illustrated) is rated at 20 watts RMS and has a frequency response of 30-18,000 C/s. Frequency response quoted is conservative. See the reviews in "Electronics Australia," p. 131, Dec. 65; "Hi-Fi News," p. 75, June 65; and "The Gramophone," p. 511, April 65.

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(Richard Allen or Stentorian speakers may be substituted.) With Sony TC250, a stereo tape deck, 2 speeds, fitted with recording and playback amplifiers **$328**

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3 Pioneer 204B stereo amplifier with AM/AM/FM/SW tuners, Labcraft 605 turntable, All-Balance tone arm, ADC-770 diamond cartridge, two Celestion "Ditton 10" speaker systems **$329**

4 Leak "Stereo 30" full transistorised stereo amplifier, two wide range Celestion CX2012 co-oxial RS/DD speakers **$318**

5 Sansui SM34 stereo amplifier with AM/AM/SW tuners, Garrard Lab 80 automatic turntable with ADC770 cartridge, two 10in Wharfedale RS/DD speakers **$299**

6 The new Garrard Lab 80 automatic turntable with ADC-660E elliptical diamond cartridge .. **$114**

7 Orpheus Silex transcription turntable, Pritchard tone arm, ADC10E cartridge **$137**

8 Pioneer SMB161 stereo amplifier with AM/AM/SW tuners, Labcraft 643 turntable fitted with B & O stereo diamond magnetic cartridge, two 8in Wharfedale RS/DD speakers. (Save $10 by using the Roland FAX150 stereo amp.) (With Labcraft 605 t/t, All Balanced tone arm and ADC770 cart.) $205. .... **$185**

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The Special offers made from time to time by Encel Electronics in "Electronics Australia" (Page 15) are kept open for several months. In the majority of cases, the prices quoted are still applicable. Please check with us!

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QV08-100	750	130	1.5	220
QV08-200	600	150	1.5	240
QV2-250C	2000	100	1.5	300
QY3-65	3000	15	1.0	130
QY3-125	3000	23	1.0	228
QY4-250	4000	50	1.0	454
YL1150	600	100	1.0	109

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Technical Review

TRUE 3D PHOTOGRAPHS USING LASER OPTICS

In the May, 1965, issue we made brief mention of a new system of 3D photography which seemed to offer, for the first time, genuine "free vision 3D". More recently to hand is a report ("Electronics World") describing the system in detail and, inasmuch as this development represents a major scientific breakthrough, we are reproducing the major portion of the article.

By E. N. LEITH and J. UPATNIEKS *

BY using the special characteristics of the laser, it is now possible to create a black-and-white, three-dimensional image of an object from a two-dimensional photographic transparency without the use of any special optical viewing devices. With this new photographic system, the viewer sees a three-dimensional image suspended in mid-air. The image is, in fact, more than just three dimensional. It has all the visual properties of the original object, including change of perspective with a shift in the observer's viewing position, and parallax between near and far objects in the image. When placed side by side, image and object are indistinguishable to the viewer.

Another amazing by-product is the fact that if the original transparency is divided into many small fragments, each fragment, in itself, is capable of reproducing the original object (with some degradation in resolution).

This approach to laser photography is an adaptation of the wavefront reconstruction process invented by the European scientist Dennis Gabor in 1947. Wavefront reconstruction is an interesting type of photography that bears little resemblance to conventional photography, but can be likened to the carrier modulation methods of the electronics engineer. The light reflected from the object is treated as a modulated carrier wave which, in photographic recording, is mixed with a local oscillator signal (another light beam) in an optical superheterodyne process.

The recent resurgence of interest in wavefront reconstruction is due in part to recent research at the University of Michigan and elsewhere, and certainly in large part to the development of the laser, which permits experiments that heretofore would not have been practicable.

The wavefront reconstruction method for photographing an object is shown in Figure 1. The procedure is in many ways similar to conventional photography, but differs from it in several significant respects. As in conventional photography, the subject is illuminated and a portion of the reflected light is intercepted by a photographic plate (or equally well, a film).

There are three major departures. First, no lens or other image-forming device is placed between subject and photographic plate; consequently, no image is formed. On the contrary, each point on the plate, instead of receiving light originating from a corresponding single point on the subject, receives light from the entire subject. Or, put otherwise, each point on the subject illuminates the entire plate.

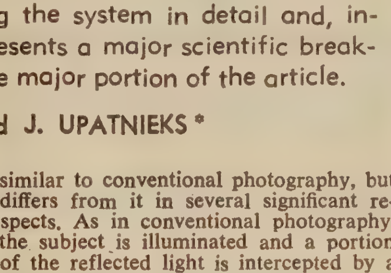

Figure 1. Making a hologram. Photographic plate receives light reflected from both the subject and a mirror. Plate records interference pattern.

Thus, no image, not even a blurred one, forms on the plate. Such a procedure would be less expected to produce more or less uniform fogging on the plate.

The second departure from conventional photography is that instead of a conventional light source a laser is used for illumination of the subject. And, as the final departure, a small portion of the laser beam is reflected onto the photographic plate by means of a small mirror, which can conveniently be located next to the subject. These two innovations in part compensate for the absence of the image-forming lens. The resulting photographic plate is now more than merely fogged — but does not contain any sort of a recognisable image.

Recorded on the photographic plate is the interference pattern between the light waves scattered from the subject and the auxiliary beam, which we call the reference beam.

If, for the moment, we consider the subject to be replaced by a mirror, then falling on the photographic plate will be two plane waves, one from each of the two mirrors. Also, let the two plane waves be non-parallel so that they impinge on the plate at some angle to each other. Because of the coherence of the light, a set of uniform interference fringes will be formed on the plate, with the fringe spacing being a function of the angle between the two beams.

The fringe pattern has an amplitude distribution which is sinusoidal and is a two dimensional spatial analog of the temporal sine wave basic to electronic communication systems. And just as the temporal sine wave can be modulated and serve as a carrier wave, so the fringe pattern can be modulated.

Let us now remove one of the two mirrors, replacing it with our original subject. The light waves reflected from the subject have an irregularity which is related to the reflecting-surface irregularities of the subject. The fringe pattern, which before was regular, now acquires an irregularity which is manifested in two ways. First, there are variations in the contrast of the fringe pattern. Second, there are variations in the fringe spacing; in some areas the fringes will be more closely spaced, while in others they are more widely separated.

The fringe pattern is thus modulated in accordance with the irregularities produced in the wavefronts by the reflection from the subject. The amplitude distortions of the reflected wave cause a contrast modulation, or amplitude modulation, of the fringes, while the phase perturbations produce a phase modulation of the fringe pattern. Thus, the recorded fringe pattern contains information completely describing the light waves reflected from the subject.

The light waves reflected from the subject and impinging on the plate can be compared to radio waves carrying intelligence, except that the frequency of the light wave being used is many orders of magnitude greater then the kilocycles or megacycles of the radio

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* Institute of Science and Technology, The University of Michigan, U.S.A.

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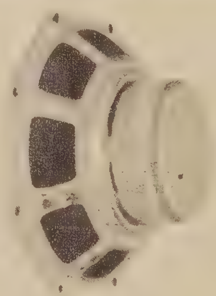

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wave. These light waves carry information about the objects from which they were reflected in the form of phase and amplitude modulations. These modulations, however, are spatial rather than temporal. Thus, the amplitude and phase of the light is different at each point on the recording plate. The light wave falling on the photographic plate from the object might be likened to a modulated carrier wave, while the light reflected from the mirror performs the same function as the local oscillator.

The photographic plate serves two purposes. The first is an obvious one: the plate acts as a storage device, storing the recorded waves for later use. The second function, less obvious but none the less essential, is that of an optical detector, analogous to the detector in a receiver. The photographic plate, since it responds to intensity, records the square of the sum of the light waves received from the object and the mirror.

The plate is thus a square-law device and produces, through detection, a difference-frequency signal. This new signal is analogous to the IF in a receiver, except that it is a spatial carrier wave instead of a temporal one. This modulated spatial carrier, or fringe pattern, which contains the intelligence that was on the light wave, is the signal that is stored on the photographic plate.

The process bears a close resemblance to sound recording where sound waves are converted into modulations of the grooves of a phonographic disc.

To carry out this recording process, the light must have two special properties: spatial coherence and temporal coherence or monochromaticity. If the light is not monochromatic, then the recording will be duplicated for each wavelength component. The fringe pattern on the plate will be washed out, and only a uniform darkening of the plate will result. Similarly, if the light lacks spatial coherence, that is, if the light has not been effectively derived from a point source, then each effective point of the source will similarly duplicate the entire modulation process, and the fringe pattern will be ruined. Thus, the subject to be photographed must be illuminated by a spatially coherent, monochromatic source, and the laser is by far the best of such sources.

The photographic record produced is called a hologram. When viewed in ordinary light, it is completely unintelligible, yet it contains in a peculiar way, all the information necessary to recreate the original subject.

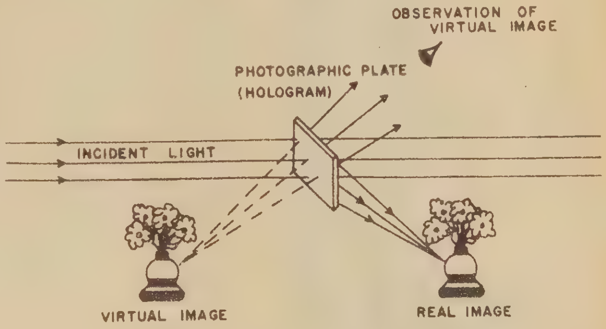
The recreation, or reconstruction process, is carried out by placing the hologram in a laser beam. As the light waves pass through the plate, they interact with the recorded fringe pattern. Emerging from the plate are three sets of waves, as shown in figure 2. One of these sets, the one which is undeviated, is of no interest. The other two wave sets, which are analogous to the sum and difference frequencies that are generated by an electronic mixer, are spatially modulated in accordance with the modulations on the fringe pattern.

These waves thus resemble the original waves which were recorded by the plate. One of the wave sets is in fact identical to the original waves and can be focused by a lens to form an image of the original subject, even though the original subject is no longer present.

If the wave set is intercepted by an observer, he will interpret it as coming from a subject located on the other, or source, side of the plate, at the same position relative to the plate as was occupied by the original subject. Thus, the observer looks through the hologram plate as if it were a window, and through it he sees what may be called a "ghost subject."

The other set of waves, which is deviated in the other direction, is similar to those waves which exposed the plate but differ in having a complementary or conjugate property, which results in the formation of an image on the side of the plate away from the source. This is called a real image and appears to be suspended in space between the hologram plate and the observer. Although the observer often has difficulty focusing on this image, it can, under the proper conditions, appear even more dramatic than the other, or virtual image.

Figure 2. Reconstructing the image. Laser light passes through plate and produces both real and virtual images.



The reconstructed images have several interesting properties other than those pertaining to their three-dimensional nature. First, each part of the hologram, no matter how small, reproduces the entire image. Thus, it may be broken into small fragments, with each fragment producing the entire picture. However, as the pieces become small, resolution is reduced, since resolution is related to aperture and the fragment size is the aperture of the imaging process.

This curious property can be understood by recalling the statement made earlier—that each point on the subject illuminates the entire plate. Thus, every point on the subject is contained in every part of the plate, and each part thus reproduces the complete subject.

Another curious property is that the process does not produce a negative. The hologram, as made in the above-described manner, would ordinarily be regarded as a negative, but the image that it produces is a positive. If the plate were copied, for example, by contact printing, the image reconstructed from the copy would also be a positive. Negatives just do not occur.

This phenemenon, upon further examination, becomes less strange. The image is recorded on the plate in the form of a modulated wave. Contract printing, for example, causes only a reversal of the polarity of the wave, just as does a vacuum-tube amplifier in typical circuit arrangements. However, polarity reversal of an RF waveform does not alter the detected signal, whether it be a sound wave or a television display. Similarly, the reconstructed image from a hologram is insensitive to polarity changes in the carrier wave.

Finally, the contrast rendition or grey scale of the reconstructed image is always very nearly that of the original subject. This is true regardless of the gamma, or contrastiness, of the photographic emulsion. In particular, the hologram can be recorded on an emulsion which does not produce grey scales, such as the high-contrast emulsion for photography of line drawings.

The resulting hologram will then have only two levels of photographic density —transparent and opaque—but the reconstructed image will have a complete grey scale which essentially matches that of the original object.

Because no viewing optics are used, the usual optical limits and distortions do not apply in this method of photography, where hologram microphotos having resolutions of only one angstrom have been produced.

With the demonstration of high-quality, three-dimensional imagery, we have turned our attention to possible applications. Certainly, simulation and training devices and general three-dimensional display systems are natural areas of application. Three-dimensional motion pictures and television seem obvious and exciting possibilities.

It must be recognised, however, that application in these areas, while possible, is technically difficult. For example, bandwidth demands of a hologram television system would be enormous, possibly 100 times that of conventional television, unless one were willing to compromise in attaining the dramatic effects inherent in the wavefront reconstruction method.

Applications in microscopy have been proposed and demonstrated. Gabor, many years ago, proposed to improve electron microscopy by making a hologram with electron waves and reconstructing it in the visible region, where one has better control of system aberrations.

Several years ago El-Sum and Baez, formerly of Stanford University, demonstrated wavefront reconstruction at X-ray lengths, with the reconstructions being made in the visible region. By this technique, it is possible to produce sharply focused images of objects illuminated with X-rays, even though it is in general not possible to focus X-rays. The difficulty in achieving coherence in X-ray sources has been an obstacle, but this difficulty may in time be overcome.

Other applications can be expected to develop, particularly as a result of advances in laser technology.

("Electronics World," Oct., 65)

ANOTHER LEAK TRIUMPH !

In 1945 LEAK released a revolutionary high fidelity amplifier . . . the famous "Point One" series. For the first time power amplifiers were marketed with a distortion content of less than 0.1%. Advertisements at the time stated—". . . *these figures establish such radically new standards that they may occasion some surprise. We therefore wish to stress that no error appears in this announcement*". Communications laboratories with accurate measuring facilities checked LEAK claims . . . and placed substantial orders. Audio engineering history was made!

Since this time LEAK engineering and design have been a step ahead; the release of the solid state LEAK "Stereo 30" is another first for the LEAK organization. Harold Leak says . . . "*This is the finest amplifier we have ever designed!*". The "Stereo 30" offers the discriminating music lover studio quality sound reproduction, advanced audio engineering and pleasing aesthetic design. Nothing can be added to the circuitry to improve performance for the "Stereo 30" represents the highest standards obtainable.

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SPECIFICATIONS:

TRANSISTORS: 2-AC107, 4-GET113, 2-0C44, 2-AF118, 2-GET538, 2-AC12/Z, 4-AD140.

DIODES AND THERMISTORS: 2-20AS, 2-VA1055, 2-VA1039.

POWER OUTPUT: Ten watts per channel into a 15 ohm load. Fifteen watts per channel into a 4 ohm load. (Both figures are IHFM music rating).

POWER CONSUMPTION: 40 watts.

INPUTS: Five position switch for Pick-up (Mono or Stereo), Tape Head (Mono or Stereo), Tuner (Mono or Stereo), Tape Amp. (Mono or Stereo) — and Microphone (Mono or Stereo).

SENSITIVITY: **Pick-up** . . . 3.5 mV at 47k ohms, 20 mV at 33k ohms, 60 mV at 100k ohms. **Tape Head** . . . 3mV at 40k ohms. **Tuner** . . . 100 mV at 100k ohms or 500 mV at 50k ohms. **Tape Amp.** . . . 125 mV. **Microphone** . . . 3 mV (Mono or Stereo).

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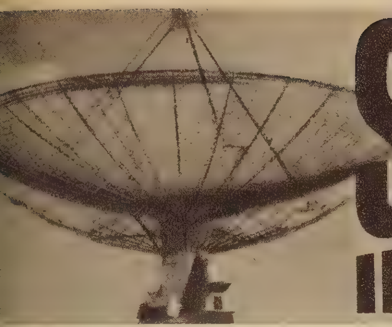


SCIENTIFIC AND INDUSTRIAL NEWS

No nuclear fusion yet

Several problems still have to be overcome before the power of nuclear fusion can be used for peaceful purposes, says a report by the International Atomic Energy Agency (I.A.E.A.) after a review of over 100 papers read to a meeting in Britain in September of more than 270 of the world's leading specialists in nuclear fusion research.

Looking back over the meetings, the I.A.E.A. report says there has been a pronounced development in the subject from early speculation, through controversy, to general agreement. Now there seems to be substantial unanimity on what is observed in major experiments wherever they are undertaken. The same situation is largely true of the theoretical work and the correlation with experiment has noticeably improved. However, better understanding does not necessarily mean that the problems look any easier — though they now can be more clearly defined.

The ultimate objective is to hold an assembly of extremely hot ions and electrons (a plasma) in isolation until nuclear fusions cause a net gain in energy. Magnetic fields around the plasma still seems the only feasible way of ensuring isolation from other matter, and despite multiplicity in the designs of these magnetic traps, the problems still look formidable.

The stability of the plasma in the magnetic field remains the crucial problem. Most of the papers — both theoretical and experimental — have been concerned with instabilities, how they originate, make their presence known and how they can be prevented.

Turning to particular classes of experiments, some difficulties can be foreseen for the open-ended traps which accept plasma losses from the ends in the hopes of stability. At low plasma densities it seems that traps designed as magnetic wells are not the complete solution although some of the most dangerous instabilities are suppressed in such traps.

Experiments at higher densities (e.g. thetatrons) suffer from troublesome loss processes from the ends of the trap which may not be quite such an obstacle at lower plasma densities. Established experiments using closed line traps such as Stellarator, Tokomak and Zeta, have all made progress, though the plasma containment times remain well short of those essential for the realisation of a net gain in energy. New toroidal (ring-shaped) magnetic trap systems have been discussed which are likely to give rise to a further generation of closed-line experiments. Substantial improvements have been reported on the development of plasma guns and in the efficient introduction of hot dense plasma into magnetic fields.

The report added: This clear, hard look at the problems of nuclear fusion research has shown that there are still several instabilities to be overcome in the various plasma traps before a definite answer can be given to the question, "Is it possible to make a controllable nuclear fusion reactor for electrical power generation?"

Instant heat for car seats

Car seats which warm up immediately until the car heating system comes into play are available as an extra on Cadillac cars this year. They keep driver and passenger warm during the time required for the engine coolant to heat up enough to discharge warm air into the car.

Carbon cloth panels made by the carbon products division of Union Carbide Company, 270 Park Avenue, New York, are inset into the back and seats of the car. Current from the generator warms these as soon as the engine starts. The carbon cloth is made by winding resistive carbon yarn with glass fibres for insulation and then weaving it into cloth.

Produces smooth wire

A new wire-drawing technique in U.S.A. is said to produce a product with an unusually smooth surface. Bell Telephone Laboratories of 463 West Street, New York City, draws the wire while it is immersed in a bath of liquid subject to ultrasonic vibration. This keeps in suspension any impurities which might otherwise settle on the wire and cause embedded particles or scratches.

Chemicals stop flame in wood

A fireproofing agent designed for incorporation into chipboard and other wood-based materials is claimed to act so effectively that even when the finished product is exposed to very high temperatures it will char without supporting the fire in any way. It contains boric acid and antimony trioxide and is added to the product during manufacture with the glue and other constituents. Manufacturers of this product are August Moralt Holz-Industries, of Bad Tolz, Oberbayern, West Germany.

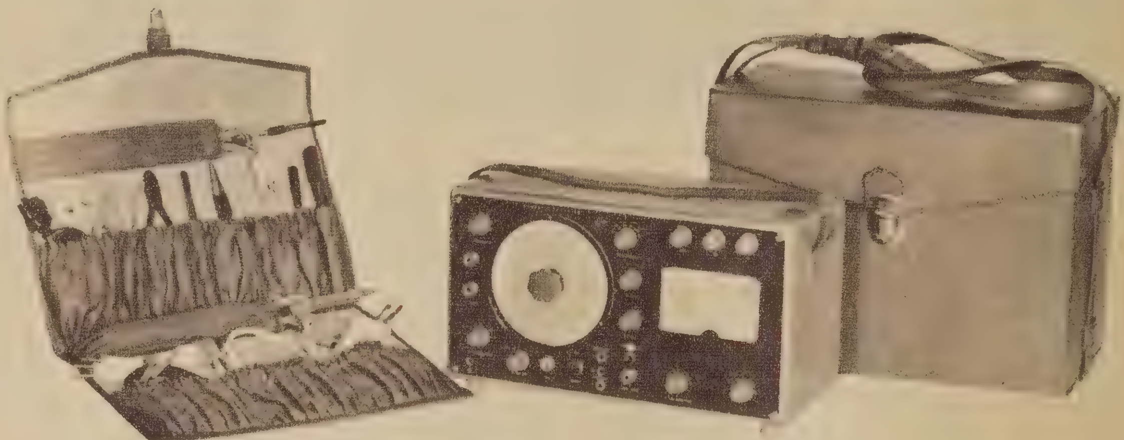
Helps wood keep its colour

A process for reducing discoloration of wood, caused by sunlight and ultra-violet light, has been developed by Deutsche

A Honeywell 200 computer which automatically translates into its own language programs originally written for other computer systems has been ordered by The Broken Hill Pty. Co. Ltd. It will be used with other computer equipment for payroll records of the company's 11,500 employees, stores inventory control, scientific and engineering calculations and statistical operations. A 200 computer is seen here in the Honeywell Service Centre, Sydney.

METRIMPEX PORTABLE TV TESTER TR-0809

lightweight - compact - tests every stage



Designed for use with TV receivers the TR-0809 is a compact, light and portable unit which provides test and measurement facilities for every stage and function of a TV receiver. This instrument, which is of high accuracy, is suitable for use in fixed locations—laboratory and service sections—also in the field. It can also be used for servicing radio receivers.

Among the many facilities provided is an inbuilt valve voltmeter which is, itself, an extremely useful instrument apart from its application to TV receiver service. This VTVM has 20 ranges covering DC and AC volts, also resistance.

The TR-0809 is housed in a metal case fitted with a leather carrying handle and finished in hammertone lacquer. A leather carrying case with shoulder strap is also supplied as standard equipment.

SECTIONS INCORPORATED IN THE TR-0809

HF Signal Generator (5.2Mc/s-220Mc/s)
Pattern Generator with sync pulses
FM Intercarrier Generator (5.5, 6.5Mc/s)
RF Signal Generator (200Kc/s-6Mc/s)
Crystal Oscillator (5Mc/s)
Audio Generator (1000c/s)

Valve Voltmeter:
- DC: 50mV-1000 Volts (7 ranges)
  100V-20KV with probe
- AC: 50mV-300V (6 ranges)
- Resistance: 0.1 ohms—
  1000 Megohms (7 ranges)

Mixer circuit for calibration and measurement.

ACCESSORIES

A comprehensive set of accessories and tools—even a soldering iron—forms part of the equipment. This is stowed in a strong fabric holder which, during transport, is housed in the leather case accommodating the main equipment. This assembly thus makes a complete and convenient set-up for servicing n the field.

Assembled co-axial cable
Measuring Lead
Balancing Transformer
H.T. Probe (up to 20KV)
Ground Clamp

Mains Connector, 6 spare fuses
Leather carrying case with shoulder strap
Operating Instructions
Soldering Iron (24V—plugs into unit)
Set of Tools (Screwdrivers, pliers, etc.)

PRICE £150 F.I.S. all capital cities with all accessories (plus tax @ 12½%)

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LAUNCESTON (2-5322)

Advance Produktion G.m.b.H. of Nibelungenstrasse, Lautern/Odenwald, Germany. The process is particularly intended for wood used for furniture and household fittings.

The timber is treated successively with a hot alkaline solution, an acid solution and an impregnant solution containing an ultra violet absorber. The company claims that the tendency for wood to take on a red-brown colour over the years is drastically reduced.

Submarine barge has brakes

A submersible barge, said to have little underwater resistance, to be suitable for towing at relatively high speeds at sea, and readily controlled by a quick-response braking system has been designed by Shin Mitsubishi Heavy Industries, of 10, 2-chome Marunouchi Chiyoda-ku, Tokyo, Japan.

The braking system is controlled by compressed air cylinders mounted in tanks in the fore and aft sections of the vessel and is designed to stop overshooting of the towing vessel when speed is reduced. The vessel could be used for rubbish disposal, fast sea transport and ship-to-shore unloading.

This impressive aerial array is used by the Atomic Weapons Research Establishment at Aldermaston, England, for studying electromagnetic radiation from the sun, as part of the non-military work included in the Establishment's experimental program. The Establishment is also developing an early warning system for the Concord supersonic aircraft to give advance notification of faults which may occur in supersonic flights.

Metallised graphite

What is claimed to be an original method for the diffusion saturation of graphite powders by the transition method to form carbides on the surfaces of the particles, is claimed by the Odessa Polytechnical Institute (Poroshkovya Metallurgivy No. 9, 1965, Vol. 9, 33). The important feature claimed for the technique of obtaining carbides on graphite surfaces is that no reducing medium such as hydrogen is required.

The Russian research involved in this development, in a field which is becoming increasingly important for the manufacture of electrical carbon components, antifriction devices and engineering parts, also showed that it is possible to obtain titanium, molybdenum and tungsten carbides on the surfaces of the powders.

Ice-removing chemicals

After tests of many chemicals, the United States authorities have selected a mixture of 75 per cent tripotassium phosphate and 25 per cent formamide as the best for removing snow and slush from airport runways at temperatures down to —10 degrees F (—23 degrees C). Tests were conducted by the Monsanto Chemical company at Dayton, Ohio, and it was found that the mixture caused less damage to runway surfaces than salt and sand mixtures currently in use.

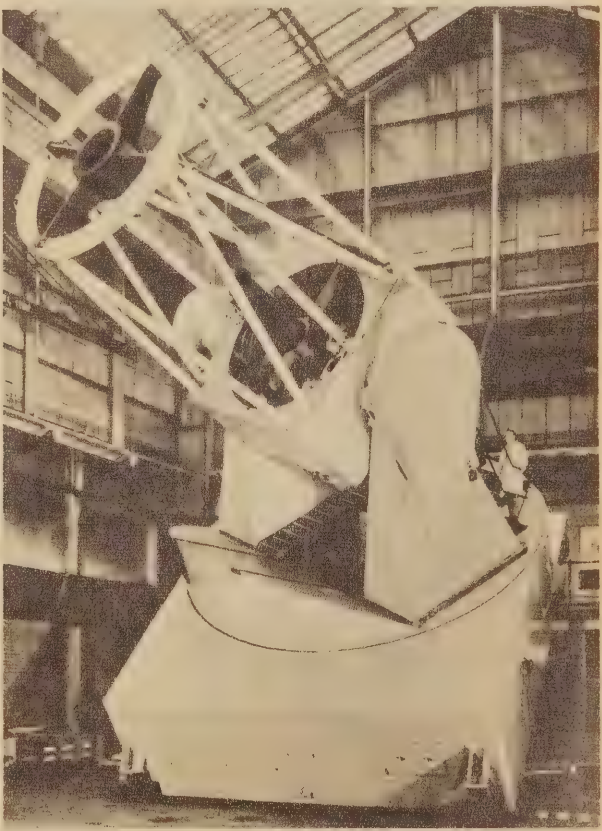
It was also concluded that the mixture could be produced at reasonable cost, bearing in mind that the eight largest airports in the United States spend about one million dollars a year on snow clearance. The mixture is to be tested for its effects on grass and rubber at the National Aviation Facilities Experimental Centre, Atlantic City, New Jersey.

Records played from below

In a small and compact portable record player reported by Nippon Columbia K.K. of 125 Minato-cho, Kawasaki, Japan, the pick-up and stylus play the record from underneath. The company states that it plays when the case is horizontal or in any inclined position and is therefore well suited for outdoor use. The pick-up arm automatically moves into the playing position after a record is placed on the turntable and the lid closed.

Anti-slip for locomotives

An anti-slip device for locomotives consisting of an electric pulse generator coupled to a sand scattering box has been



The Royal Greenwich Observatory, at Hurstmonceux Castle, Sussex, U.K., will soon have a 98 inch telescope, which will be the largest in Europe. The instrument is seen in the picture at the works of Grubb Parsons Ltd., Newcastle upon Tyne. All parts of the instrument have been made in Britain, but the raw material for the glass, worth £50,000, was a gift from U.S.A. Total cost of the telescope is approximately £691,000. It will be known as the Isaac Newton telescope, and Britain hopes that it will put the country back in the world class of astronomy.

FERRITE
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ROLA
MODELS
C6-4D and 6-4D

Typical of the complete Rola loudspeaker range, which has been tailored to meet every conceivable, practical requirement, are these two new small elliptical loudspeakers — Models C6-4D and 6-4D.

Designed to produce most sound for least input and sized to meet the requirements of modern portable or TV receivers, these space-saving speakers have a diaphragm area giving a frequency response equal to that of a normal round 6-inch loudspeaker. The modern Ferrite-type C6-4D is ideal for most applications but the Alnico magnet Model 6-4D is also available for special TV applications. The only difference between the two models is the front-to-back dimension.

Model C6-4D, a modern slimline Ferrite magnet speaker, is ideal for most radio and TV applications.

Model 6-4D is for TV Portables where the speaker is mounted very close to the picture tube.

A Unit Of The
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ROLA COMPANY (AUSTRALIA) PTY. LTD.
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leveloped by Krauss Maffei A.G. of Menchen-Allach, Germany. Vhen the driving wheel changes its rotational speed abruptly due o slip the electric pulses generated cause sand to be injected etween the rail and the wheel so that the slip is brought nder control in the shortest space of time. The control also cts on the engine to reduce the power applied to the wheels.

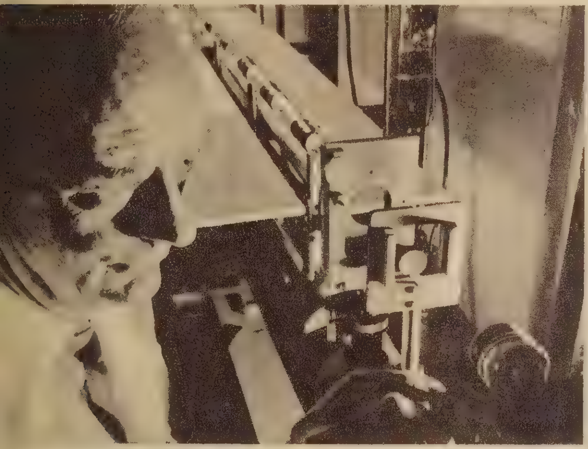
Heater for corrosive acids

An inexpensive, rugged electrical heating element for use n hydrofluoric acid, phosphoric acid and other highly corrosive iquids has been brought out by Eltron (London) of Accrington Vorks, Strathmore Road, Croydon, Surrey, England.

It is a metal-sheathed coated heater capable of continuous peration at around 130 degrees C and available either as a ortable unit or as a bank of elements for fitting into a terminal ox and mounting on the top edge of an acid bath or vat.

New PVC metal coating

Excellent adhesion of polyvinyl chloride coatings on difficult netals such as brass and copper without pre-treatment of the urface to be covered is claimed for a PVC formulation by chramm Lack-Und Farbenfabriken A.G 164 Mulheimerstrasse, ffenbach/Main, West Germany.



A program of research into the special properties of laser produced light, and the application of lasers to telecommunications, is being conducted at the Standard Telecommunications Laboratories at Harlow, Essex, U.K. In this picture, a scientist is seen making adjustments to a gas laser, developed for experimental purposes.

The plastic is mixed with hetone, epoxy resins, titanium lioxide, decalin, solvent naphtha and a barium-cadmium stabiliser. t is applied to the metal in a suspension and after a period f evaporation the coated metal is stoved for 15 minutes at 20 degrees F.

Painting under water

Alf Bjercke, of Oslo, has developed a ship's paint that an be applied under water. The coating must be put on in hick layers—up to 3,000 microns, compared with 90-150 microns or a "thick-film" application of conventional ship's paint.

The frogmen who tested the paint say that the best ool for application is neither brush nor spray-gun, but the uman hand. A handful of paint is pressed against the hull, vhere it sticks after 20 seconds. Chemical characteristics of the wo-component, epoxy-based paint forces all water away from he hull. The paint must be used in the first 40 minutes after he two components have been mixed. It hardens on the hull n one to two days. The main use for the paint is in repair vork which does not involve docking the ship.

Semi-Conductor Course

Radio University, the transmitter operated by the Division f Post-Graduate and Extension Studies, University of N.S.W., vill broadcast a series of nine lectures, each of one hour uration, on the fundamentals and properties of semi-conductors. he date of commencement of the lectures has not yet been finalised, but enrolments for the course close February 15, 1966. For the benefit of students who miss a lecture, there will be a repeat of each one in the same week. The series has been designed for engineers and other senior personnel in industry. A seminar will be held at the conclusion of the course.

The fee for the course is £3 ($6.00), which includes the cost of printed notes essential for the understanding of the lectures. Lectures will be at 7 p.m. each Tuesday, with repeats at 7 p.m. on Thursday each week. The lecturer will be Dr. D. Haneman, who is senior lecturer in Physics at the university, and author of a number of research and review articles in the field of semi-conductors.

Enrolments also close February 14, 1966 for a course of Methods Engineering 18.811G, which is one of eight subjects of the Graduate Diploma Course in Industrial Engineering. It may also be taken as a miscellaneous subject by engineers, managers and supervisors in industry. This subject, of 40 hour-long lectures, is to be offered over First and Second Terms by Radio University, and as a tape correspondence course elsewhere on application. Cost of the course is £10, including notes. Students who are allowed to take 18.811G as part of the requirements for the graduate diploma will also be required to carry out 30 hours' laboratory work in Sydney. This will be distributed over five Saturdays in Terms 1 and 2, and there will be an additional fee for these periods. Lecturers will be Mr J. F. Close, University of N.S.W., Mr R. B. Mitchell, Colonial Sugar Refining Co., and Dr. E. R. Tichauer, University of N.S.W.

Further information can be obtained from Radio University, P.O. Box 1, Kensington, N.S.W. (phone 663 0351, ext. 2691).

Glass Airliners in 10 Years

Fibre-glass would probably be used extensively in construction of airframes for future supersonic airliners, predicted design engineers of the Lockheed-California Co., speaking at an international meeting of aircraft designers and technologists. Application of fibre-glass technology to airframe design was only five to ten years away, they said, bringing with it weight savings of nearly one-third compared to present metal construction.

A fluorescent magnifying lamp designed for working on small components was displayed at the recent "Industry '65" exhibition at Earl's Court, London, by Thousand and One Lamps Ltd., 386 Lee High Rd., London, S.E.12. The model seen here has a 22 Watt tube, and can take auxiliary lenses for increased magnification. Once moved into the desired position, it remains fixed, leaving both the operative's hands free for working.

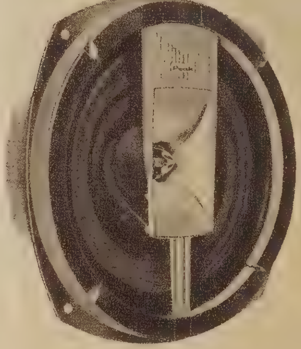
The speakers disclosed that Lockheed had devised original production techniques to build large test sections of aircraft wings of fibre-glass, and that new high-strength filaments made of glass and other elements promised the most significant advance in vehicle performance seen in many years. The new materials, known as monofilament composites, are like glass in that they have a formless non-crystalline composition enabling them to withstand temperatures of about 2,000 degrees F, and thus adaptable to supersonic flight. They also revealed that Lockheed had produced high-strength glass filamented material in sheets ready to be cut, sawn, drilled or machined like metal, or moulded like plastic.

1

2

PEAK

5



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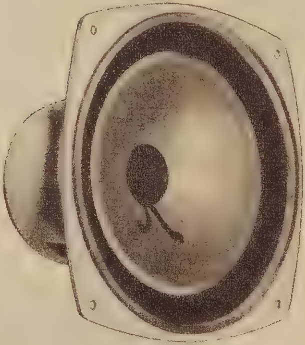

4

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Skin For Structures

Decade-X is a long-life liquid plastic which provides a decorative, protective skin to structures, according to the manufacturer, Liquid Plastics, of Ashworth Street, Preston, Lancashire, England. Applied by brush, it is stated to absorb thermal movement, bridge hairline cracks and maintain a continuous surface that can breath. It is also stated to bond perfectly to all building materials and has a covering capacity of six-nine square yards per gallon for roofing and about 15 square yards for other structures. Nine colours are available.

Special Quality Laminate

A new grade of copper-clad P.T.F.E.-glass fabric laminate has been developed by Formica Ltd. (U.K.), for printed circuit applications where very high frequencies are being used, where low power losses are essential and where high temperatures may be encountered. A typical example of its use will be found in missile technology where rapidly changing temperatures may cause frequency drift in the control equipment of the rocket thereby causing loss of contact with the ground station. It can also be used in the manufacture of radar waveguides for aircraft, or wherever microwave circuitry is employed in instruments subject to harsh environmental conditions.

The laminate is manufactured from continuous glass filament woven into a fabric, impregnated with P.T.F.E., and subsequently clad on both sides with copper foil; these materials are bonded together by means of controlled heat and pressure. A particular feature of the new laminate is its ability to withstand long periods of damp heat without serious deterioration. At present, the laminate is available in sheets with maximum size of 24 x 12 inches.

Electric Fumigator

An electrically operated portable fumigator which is said to be very effective in control of insect pests, but which is harmless to animals and humans, has been developed in U.K. by A. and A. Industrial Equipment Ltd., 14 Grosse Belgrave, Leeds 2. The fumigator is suspended from any convenient position, and when charged with a cartridge of a special insecticide, will effectively fumigate up to 650 sq. feet, of floor area, or 5,000 cubic feet of space, for a period of 15 hours. Refills of insecticide are supplied in heatproof glass jars, and running costs are said to be a few pence per hour.

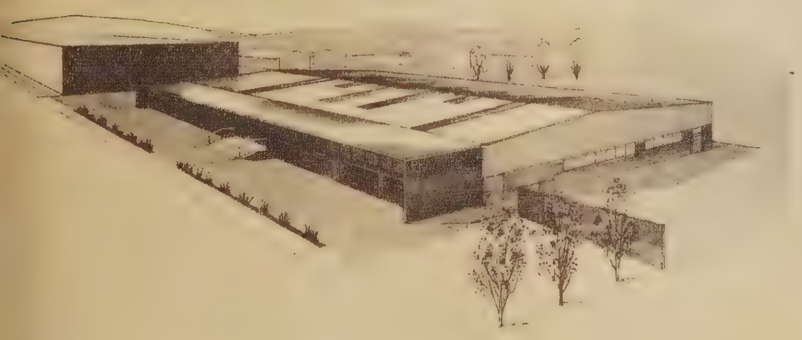
The makers say the fumigator is ideal for such places as poultry houses, cowsheds, and piggeries, but since the insecticide used is harmless to humans, and has no unpleasant smell, it may also be used in kitchens, bakeries, greenhouses and farm buildings.

The Institution of Radio and Electronics Engineers Australia has announced that His Excellency The Right Honourable Lord Casey, P.C., G.C.M.G., C.H., D.S.O., M.C., K.St.J., Governor-General of the Commonwealth of Australia, has granted his patronage to the Institution.

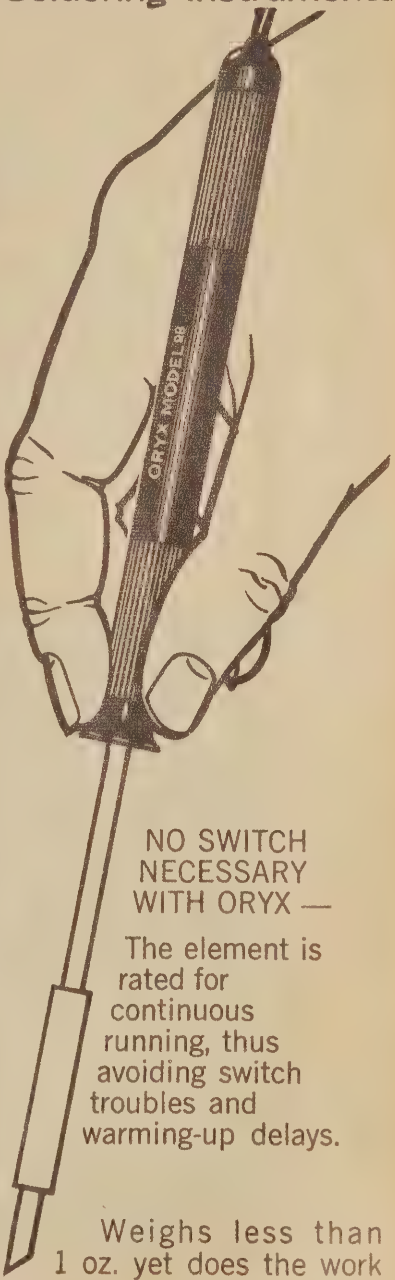
Educational TV in UK

The use of closed-circuit TV in educational establishments has grown rapidly during the past few years, and latest indications are that this growth seems likely to continue. In U.K., the Edinburgh University has ordered from the Marconi Company a closed circuit system, for its first-year science building, which will be the largest single educational TV system in Britain. It will comprise nine automatic TV cameras and 51 receivers, with comprehensive control room and wired vision and sound distribution network linking lecture theatres and viewing rooms throughout the building.

Three different programs can be distributed simultaneously to selected viewing rooms throughout the building from the control room. A feature of the system will be the comprehensive control facilities. A lecturer will be able to control the program channel selection and volume from a single point, close to his desk, for all receivers in the room. The cameras to be used will be the new Marconi V322 series, which have been designed specifically for educational TV. These cameras incorporate a number of fully automatic features, including automatic adjustment over a wide range of lighting conditions. Normally, the only electronic control that needs to be operated is the ON/OFF switch, the company says. ■



Here is an artist's impression of the newly completed factory of Zephyr Products Pty. Ltd., located on a one acre site at 70 Batesford Rd., Chadstone, Victoria, which the company will occupy in February. The site of the new factory is two miles east of the present factory at Glen Iris. The company has been based on the Glen Iris premises for 11 years, but they are now inadequate because of expanding volume of business. The office block of the new premises is self-contained, and comprises board room, directors' offices and general office. At the rear, on ground level, are the main store, production areas and goods receipt and despatch. A basement section at rear contains staff facilities, storage and production space.



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M.488

A FOUR-CHANNEL

The mixing unit described in this article has been designed especially for amateur tape recordists, movie makers and public address men. It will blend together signals from up to four sources — two dynamic microphones and two crystal/ceramic pickups. Fully transistorised, it offers outstanding performance, compactness and economy of operation. Details are also given for optional level metering and mains power supply circuits for those who wish to build a more elaborate mixing unit.

By Jamieson Rowe

In the production of tape recordings of plays or musical performances, or the compilation of film sound-tracks or slide show commentaries, it is usually found necessary to blend together in controlled amounts the signals from a number of sources — microphones, gramo pickups and tape recorders. The same situation tends to rise in all but the simplest public address installations.

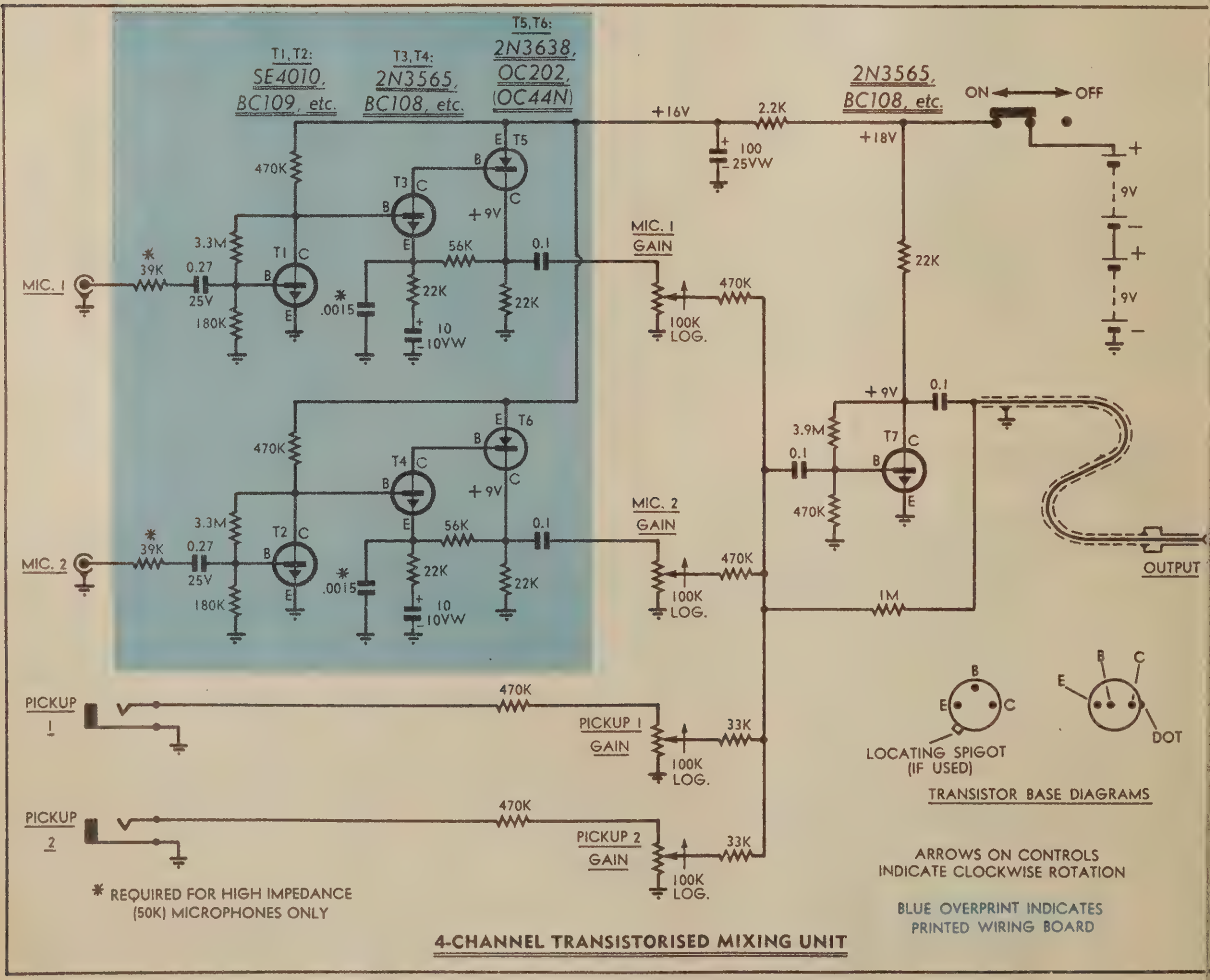
As a great many tape recorders and film amplifiers — and to a lesser extent, public address amplifiers — have rather limited facilities for mixing signals, it often becomes necessary to employ a separate device to perform the required blending and fading. The auxiliary device may be anything from a small box with a few potentiometers and resistors to an elaborate multi-channel mixing console with almost as many knobs and meters as an airliner cockpit, depending upon the complexity of the job involved.

In our experience, the majority of amateur mixing jobs can be handled quite adequately by quite a modest mixing unit — one capable of accepting signals from up to two microphones and two gramo pickups or tape recorders. Smaller mixing units tend to offer insufficient mixing facilities, while larger units b come too costly, considering the rari with which their full facilities are r quired.

The mixing unit to be described is vi tually a transistorised counterpart of a earlier and very popular mixing un which we described in December 196 It has been designed in response to number of requests for a unit havin the same high performance as the 19 design combined with the convenien of battery operation.

As with the 1961 design, the new un features inbuilt preamps for the tw microphone inputs. However, wherea the valve design would accept signa from both crystal/ceramic and dynam microphones, the new unit will opera satisfactorily only with the latter typ This limitation arises from the difficult of providing a very high impedance lov noise input circuit at reasonable co using currently available transistors. view of the present availability of higl quality dynamic microphones at mode cost, we feel it to be an acceptable quali fication.

The circuit diagram of the new mixe shows its essential simplicity. Seve


T1, T2:
SE4010, BC109, etc.
T3, T4:
2N3565, 2N3565, BC108, etc.
T5, T6:
2N3638, OC202, (OC44N)
2N3565, BC108, etc.
ON
OFF
+16V
2.2K
+18V
100 25VW
470K
T1
T2
T3
T4
T5
T6
T7
3.3M
39K
0.27 25V
180K
.0015
56K
22K
10 10VW
0.1
+9V
MIC. 1
MIC. 2
MIC. 1 GAIN
MIC. 2 GAIN
100K LOG.
22K
9V
3.9M
1M
OUTPUT
PICKUP 1
PICKUP 2
PICKUP 1 GAIN
PICKUP 2 GAIN
33K
E B C
LOCATING SPIGOT (IF USED)
DOT
TRANSISTOR BASE DIAGRAMS

* REQUIRED FOR HIGH IMPEDANCE (50K) MICROPHONES ONLY

ARROWS ON CONTROLS INDICATE CLOCKWISE ROTATION

BLUE OVERPRINT INDICATES PRINTED WIRING BOARD

4-CHANNEL TRANSISTORISED MIXING UNIT

The circuit diagram of the new mixing unit.

AUDIO MIXER

silicon transistors are used in all, three in each microphone preamp and the remaining transistor in the mixing stage.

The microphone preamps employ a circuit which has been adapted from the disc/tape preamp design published in October, 1965; the same general arrangement of a low-noise NPN common-emitter stage and following DC-coupled feedback pair is used, with the feedback altered to give "flat" response. The basic microphone preamp circuit has an input impedance of approximately 11K, a response flat within 3dB from 20cps to 50KC and a gain of approximately 375 —giving an overall mixer gain of 750 times for each of the two microphone inputs, with response flat within 3dB from 30cps to 40KC.

In basic form, then, the microphone channels have adequate gain and response for all but the very lowest impedance microphones; however the input impedance is somewhat low for the "high" impedance variety. To match the latter type, 39K input series resistors are added as shown — to provide the preamps with a standard 50K input impedance. Small capacitors must be added at the same time to compensate for treble losses introduced by the resistors.

As might be expected the input resistors drop the gain by about three times. However, this still gives an overall gain for each microphone input of 250 times, which should be more than adequate for most high impedance microphones. For low and medium impedance microphones the 39K resistors and .0015uF capacitors are omitted to give the full gain of 750.

SPECIFICATION

- Four-channel audio mixing unit using silicon transistors.
- Two dynamic microphone channels: for high impedance types, input impedance 50K with gain of 250. For low and medium impedance, input impedance 11K with gain of 750. Response 30cps to 40KC within 3dB.
- Two crystal/ceramic P.U. channels: Input impedance 500K, unity gain. Response 20cps to 40KC within 3dB.
- Designed for nominal 250mV output level but will deliver more than 5V RMS before clipping. Output impedance less than 22K.
- Mic. channels noise —54dB below 250mV output; pickup channels better than —60dB. T.H. distortion at 1V RMS output 0.15 per cent.
- Maximum control interaction 1dB.
- Operates from two small 9V batteries; drain 1.5mA at 18V.

Very low impedance microphones may be used by fitting input matching transformers. As the latter are usually intended for connection to 50K loads, the 39K resistors and .0015uF capacitors should be retained when transformers are used. A supplementary diagram shows the method of connecting input transformers to the preamp inputs.

TRANSISTORISED MIXER
M1
M2
P1
P2
ON

The completed mixing unit, ready for use.

The "pickup" inputs of the mixer will accept signals from crystal/ceramic pickups, radio tuners, tape recorders or other sources of high-level signals. They provide an overall gain of unity, with frequency response flat within 3dB from 20cps to 40KC. The input impedance is 500K for both channels.

The mixing stage itself uses a single silicon NPN transistor type 2N3565 or BC108 or similar. The stage is a conventional common-emitter amplifier but is given stable gain, low distortion and low input and output impedances by the application of negative voltage feedback. The basic circuit is shown in figure 1.

The low-impedance level produced at point "A" of figure 1 due to feedback through resistor Rf plays an important part in the operation of the mixer stage, because it ensures that the gain of the stage as seen by any of the inputs is virtually independent of the impedance connected to the other input terminals. This means that the signals can all be derived from standard gain control potentiometers without interaction between the controls.

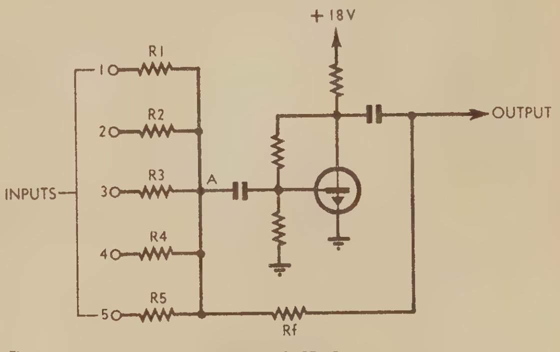


Fig. 1 BASIC MIXER STAGE

The input impedance of each input is very close to the value of its input series resistor—R1 or R2 or R3, etc. Similarly the gain of the stage for each signal is given by the ratio between Rf and the input series resistor: signal 1 receives a gain of Rf/R1, signal 2 a gain of Rf/R2, and so on.

The maximum number of signals which may be mixed together with this basic circuit depends upon the performance required, but is fundamentally determined by the gain of the stage before feedback is applied. For a given open-loop gain the maximum number of inputs to be used depends upon the input impedances and gains required for the signals, together with the noise, distortion and control interaction levels which can be tolerated.

In general, the higher the gains and input impedances required, the fewer the inputs which may be connected for a given set of noise, distortion and control interaction criteria. Thus with a single 2N3565 or BC108 as used in the present circuit, excellent performance can be obtained when mixing up to 10 medium-impedance inputs (R1, R2, etc., all equal to 47K) with a gain of 10 (Rf made 470K), or eight higher-impedance inputs (R1, R2, etc., made 100K) with a gain of 5 (Rf made 470K); but if higher input impedances and/or higher gains are required, the maximum number of allowable inputs falls.

In the presently-described four channel unit Rf is 1M, the input resistors for the microphone inputs are 470K (giving a mixer stage gain of 2 times), and those for the pickup inputs are 33K

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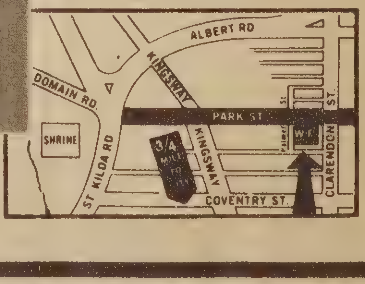
WARBURTON FRANKI



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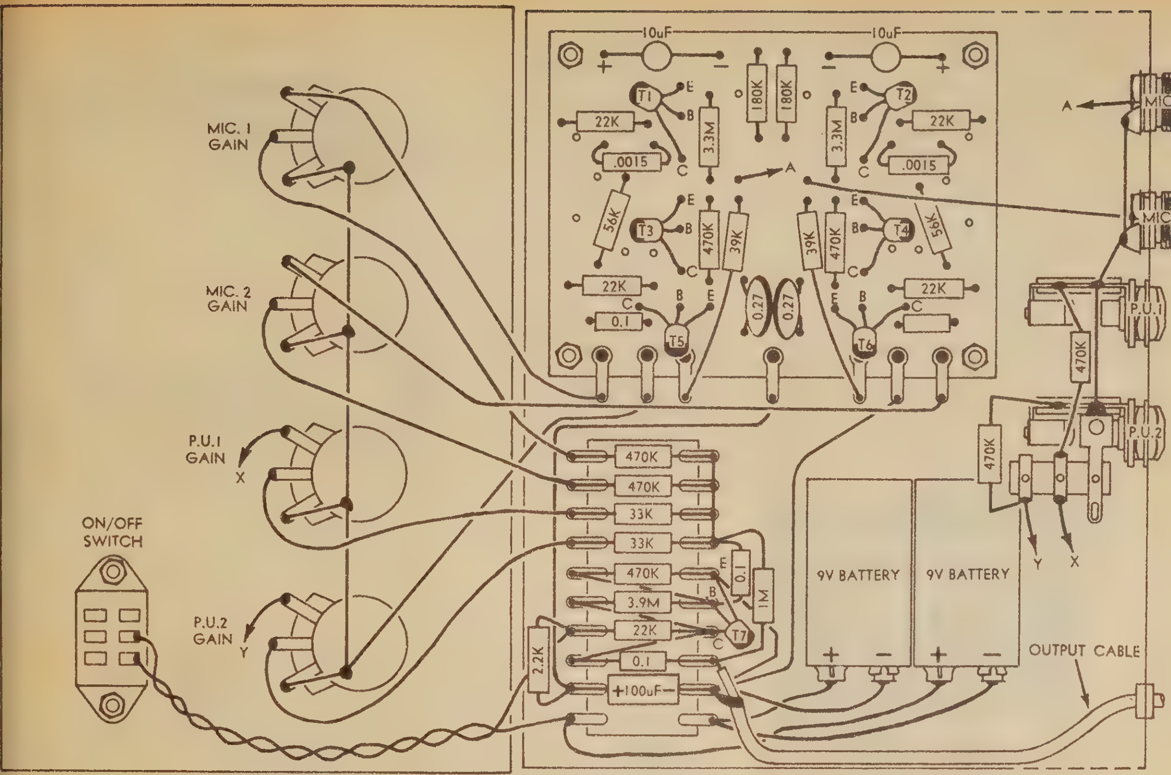


Using the complete wiring diagram shown above and the photograph below it should be easy to duplicate the original unit.

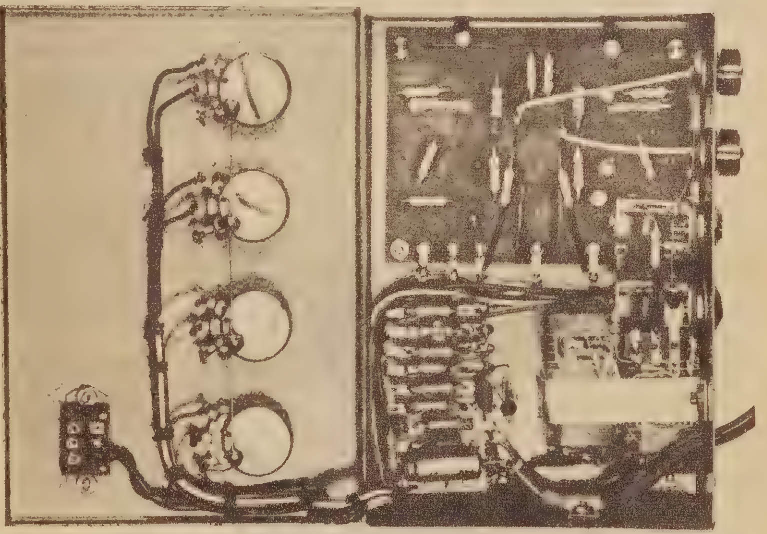
(giving a mixer stage gain of about 30 times). These values give less than 1dB total interaction between controls, with excellent distortion and noise performance. Note that although the mixer stage itself has a gain of 30 for the pickup channels, the overall gain is unity due to the voltage division produced by the 470K input padding resistors.

Before passing on to a description of the construction of the new unit a few points may be noted for the benefit of those who may wish to use the information given in this article to construct more elaborate mixing units; also for those who may simply wish to add a metering circuit or mains power supply to our basic design.

With regard to constructing mixers catering for more than four inputs: You may add up to four more microphone preamps and controls with negligible control interaction or degradation in noise or distortion, providing that you use 470K mixing resistors as shown and that a separate 2.2K supply resistor and 100uF decoupling capacitor is used for each pair of additional preamps. For single additional preamps use a 4.7K resistor in place of the 2.2K.

However, it is NOT advisable to add further pickup channels of the type shown; even one additional input of this type will produce an increase in control interaction to about 3dB, and will increase distortion. If other pickup channels are required, either add a second mixing stage or use crystal/ceramic or magnetic preamps of the type used in the December, 1965, Control Unit—together with 100K pots, 470K mixing resistors, and additional supply decoupling components as specified above for microphone preamps.

If output signal level metering is required it is NOT possible simply to add a standard 500uA level meter circuit or



COMPONENTS REQUIRED

1 Metal case, 6¼in x 4½in x 2in, with "biscuit-tin-lid" panel.
1 Printed wiring board, 65/p10.
1 Slide switch, 1 pole 2-position.
2 Transistors, type SE4010, BC109 or similar.
3 Transistors, type 2N3565, BC108 or similar.
2 Transistors, type 2N3638, OC202 (OC44N).
2 Microphone connectors.
2 Pickup jacks.
1 Shielded jack plug.

RESISTORS

Half-watt, 5 per cent: 2.2K, 5 x 22K, 2 x 33K, 2 x 39K, 2 x 56K, 2 x 180K, 7 x 470K, 1M, 2 x 3.3M, 3.9M.
4 100K log potentiometers.

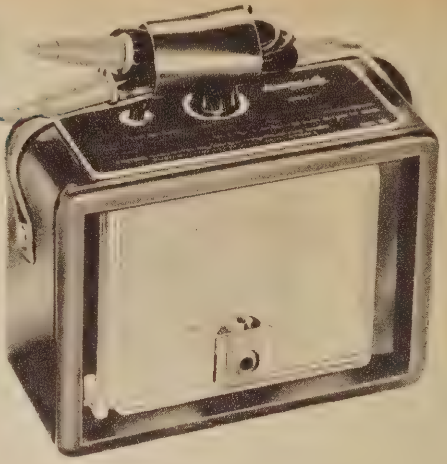
CAPACITORS

2 .0015uF LV plastic.
4 0.1uF LV plastic.
2 0.27uF LV ceramic.
2 10uF 10VW electrolytic.
1 100uF 25VW electrolytic.

MISCELLANEOUS

2 x Small 9V batteries and connector leads; miniature 3-lug tagstrip; scrap aluminium for battery and output cable straps; 4 x rubber feet; length of shielded cable for output lead; connecting wire; knobs, nuts, bolts, solder, etc.

500V "UNIMEG"
INSULATION TESTER



RANGE. .25 to 50 megohms at 500 volts test potential, with centre scale at 3.5 megohms.

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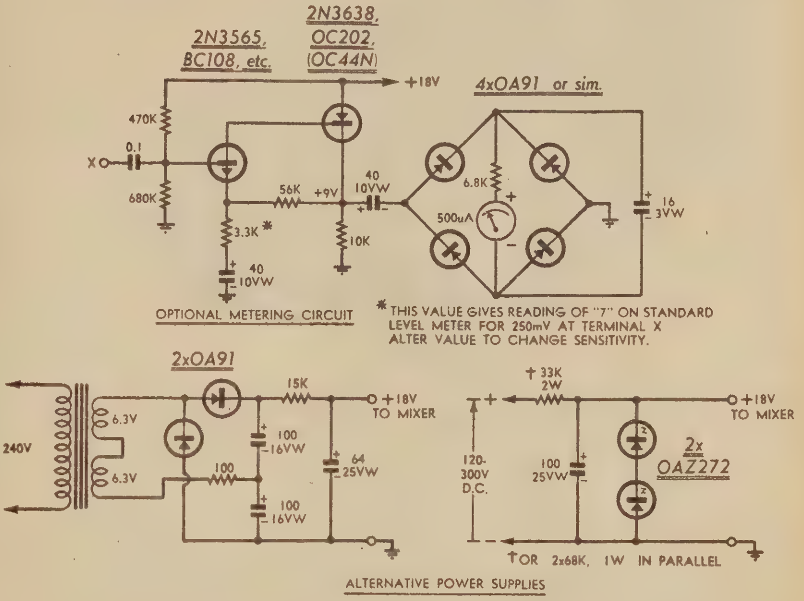
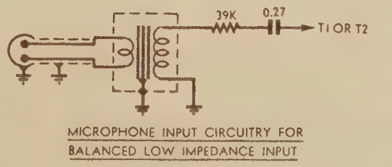
The rear panel of the mixer, showing the microphone connectors, pickup input jacks and the output cable.


2N3565, BC108, etc.
2N3638, OC202, (OC44N)
+18V
4xOA91 or sim.
470K
0.1
X
680K
56K
+9V
40 10VW
6.8K
500uA
16 3VW
3.3K *
10K
40 10VW
OPTIONAL METERING CIRCUIT
* THIS VALUE GIVES READING OF "7" ON STANDARD LEVEL METER FOR 250mV AT TERMINAL X ALTER VALUE TO CHANGE SENSITIVITY.
2xOA91
15K
+18V TO MIXER
240V
6.3V
6.3V
100 16VW
100
64 25VW
100 16VW
† 33K 2W
+18V TO MIXER
120-300V D.C.
100 25VW
2x OAZ272
†OR 2x68K, 1W IN PARALLEL
ALTERNATIVE POWER SUPPLIES

The circuit for an optional level metering section, using a standard 500uA level meter movement; also the circuits for two alternative power supplies should these be desired. The small diagram below shows how the mic. preamp inputs can be adapted for low impedance microphones.


39K
0.27
T1 OR T2
MICROPHONE INPUT CIRCUITRY FOR BALANCED LOW IMPEDANCE INPUT

a "VU" meter to the output circuit; this will load the output quite severely and cause distortion. Quite apart from this the readings will be non-linear due to the low signal level available. It is necessary to employ an amplified metering circuit.

The circuit shown uses two silicon transistors and a minimum of components, and was designed for the 500uA level meter used in our previous tape recorder projects. It has an input impedance of approximately 300K for low circuit loading, has a response flat within about 3 per cent from 20 cps to 15KC, and provides the meter with essentially "VU" meter damping. The input sensitivity for a scale reading of "7" may be varied from about 30mV to many volts, by varying the value of the resistor marked with an asterisk; with the 3.3K value shown the sensitivity will be approximately 250mV.

Although the mixing unit as described operates from two 9V batteries, it may be operated alternatively from the AC mains or from the HT supply of valve equipment. An auxiliary diagram shows the circuits for a small AC mains power supply and a zener diode supply for operating the mixer from an HT line of from 120 to 300 volts.

It should be noted that neither of these supplies should be fitted into the small mixer case used for the basic unit. Apart from the hum which will appear if the mains transformer is brought into close proximity with the preamps and mixing circuitry, both supplies generate appreciable heat energy. If either supply is used, employ a larger metal case with appropriate ventilation arrangements; and if the AC supply is used, make sure the circuitry is well shielded from transformer radiation.

Note also that both supply circuits shown are for the basic four-channel mixer, with a drain of approximately 1.5mA. If more elaborate circuits are built up the supplies will have to be altered to cater for the higher current drain. To work out the drain involved, count 0.5mA for each preamp, mixing stage and metering amplifier used.

With the AC supply the series resistor shown as 15K may be reduced to maintain the output voltage at 18V with higher drains. Note, however, that to maintain a low hum level it is advisable to increase the final filter capacitor from 64uF in the same proportion as the resistor is reduced. With the zener diode supply the series resistor may be cautiously reduced from 33K to allow for increased circuit drain; adjust the value to maintain a mixer supply of 18V.

For the time being, the foregoing information will have to suffice for those readers whose requirements will not be met by the basic mixer circuit. At a later stage we may be able to give more detailed information concerning the design and construction of more elaborate mixers, if there seems sufficient reader interest in our doing so.

And now for a brief description of the mechanical side of the new unit. As may be seen from the photographs, it is built into the compact 6½in x 4½in x 2in metal box used for a number of previous projects. The box has a "biscuit-tin lid" front panel.

The four gain controls are mounted in a row along the front panel, and the only other item on the panel is an "on-off" slide switch. The long side of the case furthest from the controls is used to mount the four input connectors and for the output cable entry. Four rubber feet complete the unit.

Inside the case the wiring is compact but not unduly crowded; standard components are used throughout. The preamps are wired on our 65/p10 printed wiring board, as used for the October, 1965, stereo disc/tape preamp, to simplify the wiring (they could, of

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course, be wired up on tagstrips or resistor panel if so desired).

The mixing circuitry is wired on a 10-lug section of miniature resistor panel. A small 3-lug miniature tagstrip supports the two 470K pickup input padding resistors at the pickup jacks. The two small 9V batteries are held securely in place by a small strap bent up from aluminium scrap; a small "C" clamp of the same material is used to anchor the output cable.

Construction of the mixer unit should be a relatively straight-forward task even for beginners, as we have provided a complete wiring diagram. Using this in conjunction with the circuit and photographs there shoud be no difficulty in producing a close copy of the prototype and obtaining similar performance.

The suggested order of assembly is as follows: After preparing the metalwork, wire up the preamp components on the printed board and the mixing components on the resistor panel. Then fasten the two wiring assemblies into the case; both mount by means of 1/8in Whitworth screws, using nuts to space them from the case bottom. The spacing for the printed board is equal to the thickness of one 1/8in nut, while that for the resistor panel is about ¼in. Note that two of the printed board mounting screws are used to fasten rubber feet to the case.

With these assemblies fitted into the case it will be an easy matter to wire in most of the interconnections between them and the front panel components. Finally add the input connectors, the batteries and the output cable.

If the wiring diagram and circuit are followed carefully, the unit should work within seconds of being switched on. And with a battery drain of only 1.5 milliamps, it will operate from the two small 9V batteries for almost as long as their shelf life. ▬

INERTIAL GUIDANCE

(Continued from Page 7)

and actual targets is said to be "in excess of blocks."

The LN-14A system displaces a total of 2.7 cubic feet and weighs approximately 150lb.

COMMERCIAL SYSTEM: Litton now is developing LTN-50, the first system for commercial aircraft. The company expects that the price for LTN-50 inertial systems will be much less than the price of an equivalent system in current production.

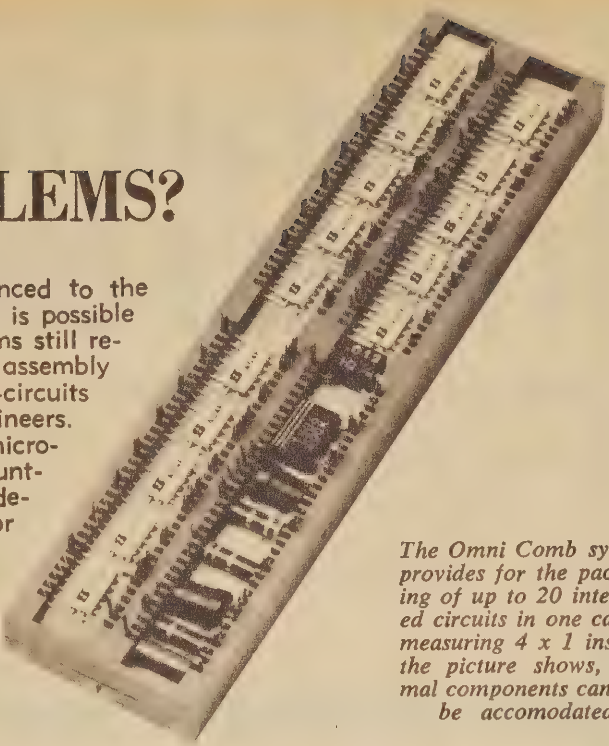
The LTN-50 is built around a low-cost four-gimbal platform using two two-degrees-of-freedom gyros and three accelerometers. It employs digital computation with a digital differential analyser that can be augmented for expanded applications with a general purpose digital computer. Functionally the new system is similar to systems built for naval use with the notable exception of using digital rather than analog computation. The platform assembly contains all of its own electronics and power supplies and externally presents a digital interface with the digital differential analyser.

Litton predicts one order of magnitude of reliability improvement over current production equipment. The use of unusual new gyros gives it a navigation performance of better than 2.1 nautical miles per hour 95 per cent of the time. ▬

ls this a solution to

MICRO-CIRCUIT MOUNTING PROBLEMS?

While micro-circuit technology has advanced to the state where production of circuit elements is possible at reasonably economic cost, many problems still remain to be solved, particularly in equipment assembly techniques, where the small size of micro-circuits can itself be a problem for production engineers. A number of companies producing micro-circuits are working on the problems of mounting, and we were recently shown a system developed in U.S.A. by the Elco Corp. for packaging micro-circuits, which seems to contain the answer to many of the problems involved.



The Omni Comb system provides for the packaging of up to 20 integrated circuits in one carrier measuring 4 x 1 ins. As the picture shows, normal components can also be accomodated.

The new system, called Omni-Comb, s expected to be of particular value to omputer manufacturers, and others con erned with the design of equipment ising micro-circuits. Universities and echnological institutes are also expectd to find great benefit in the system.

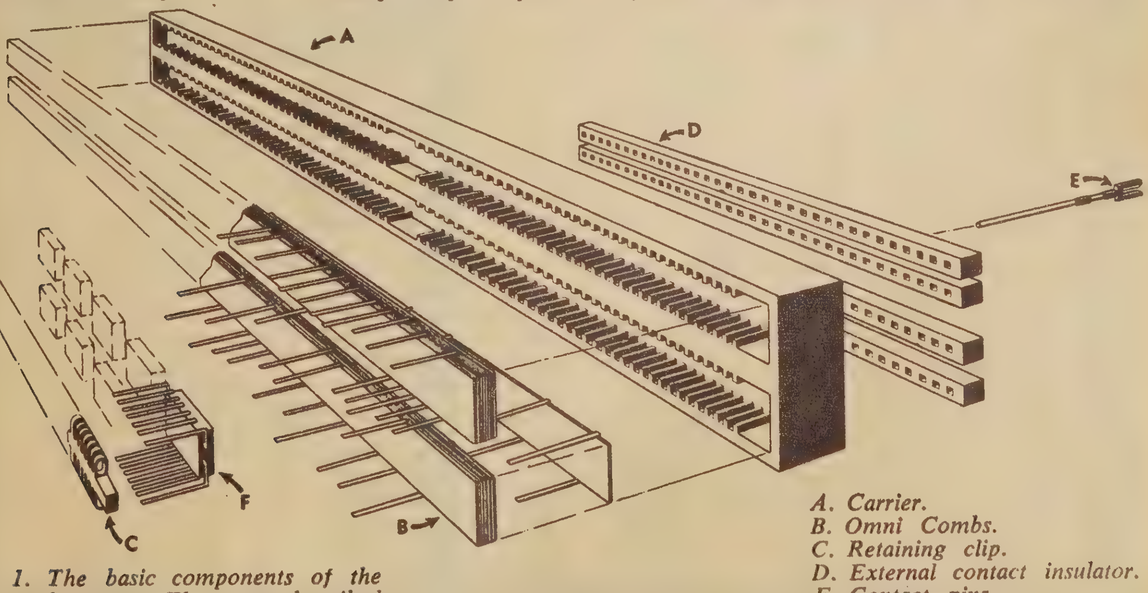
The Omni-Comb system is designed o be a mounting and interconnection ssembly for integrated circuits of the ype known as flat packs. These conist of a small substrate (base) of square r rectangular format, usually not more han 5-6mm on the longest side on vhich the minute circuit elements are nounted. From these circuit elements, iny leads are taken from the substrate o the longest edge and arranged in two ows, for connection to inter-circuit eads.

These flat packs have certain comnon features, because of the realisation mong U.S. manufacturers that some egree of standardisation would be an dvantage for the whole industry. (A imilar situation already exists in the valve manufacturing industry, of course, with standardisation of valve pins.) As a result of this, flat packs have either ten or fourteen leads, spaced on .05in centres. The appearance of a flat pack is shown diagramatically in figure 2, while figure 1 contains a sketch of a flat pack with pins folded to a 90 degree angle.

The use of integrated circuits in the manufacture of computers, and similar equipment requiring large numbers of discrete circuit elements, has various advantages, the most significant of which is probably the dramatic reduction in size possible with their use. However, the full potential for miniaturisation offered by integrated circuits has not been fully realised, because of the relatively bulky components required for mounting each individual flat pack in position.

Another problem has been the tricky job of interconnecting the integrated circuit leads to other parts of the subassemblies. At one stage, the microcircuits were fitted by hand to printed circuit boards, but the difficulties of guiding the tiny pins into matching holes, hand soldering and point-to-point wiring resulted in too many rejects. Furthermore, in-service testing involved the tricky and time-consuming task of removing flat packs from the printed circuit boards for checking.

Much design work has been carried out to find suitable solutions to these problems, and one idea which has found favour is illustrated in figure 3. With this method, the flat pack is first mount-



igure 1. The basic components of the mni–Comb system. These are described in detail on page 37.

A. Carrier.
B. Omni Combs.
C. Retaining clip.
D. External contact insulator.
E. Contact pins.
F. Integrated circuit pack.

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TRS215	1.0	1.18 + 1.18:1	84 CT	15.0
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TRS183	1.0	2.6 + 2.6 :1	93 CT	3.5
TRS242	1.0	1.25 + 1.25:1	93 CT	15.0
TRS197	1.0	1.83 + 1.83:1	200 CT	15.0
TRS120	1.5	2.3 :1	20 SE	3.5
TRS218	2.0	2.63 + 2.63:1	120 CT	3.5
TRS219	2.0	2.63 + 2.63:1	120 CT	3.5
		or	or	
		2.85 + 2.85:1	130 CT	
TRS163	4.0	2.36 :1	20 SE	3.5
		or	or	
		1.18 :1	5 SE	
TRS233	6.0	0.69 + 0.69:1	30 CT	15.0
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TRS119	10.0	0.13 + 0.13:1	33 CT	500, 250, 125
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TRD216	S.E. to P.P.	2.5 :1 + 1	5,000 S.E.	3,000 C.T.
TRD108	S.E. to P.P.	2.4 :1 + 1	3,000 S.E.	2,000 C.T.
TRD174	S.E. to P.P.	2.4 :1 + 1	3,000 S.E.	2,000 C.T.
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TRD223	S.E. to P.P.	2.5 :1 + 1	600 S.E.	300 C.T.
TRD117	P.P. to P.P.	2 + 2:1 + 1	420 C.T.	105 C.T.
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ed into a small holder, and the holder is fixed by means of small spigot pegs into a carrier board with printed circuitry which provides the interconnection facility by edge connectors.

This method has the advantage that individual flat packs can be removed from the equipment for testing, but remain in their holders, thus simplifying handling. Point-to-point wiring is made easier by the edge connectors. However, it will be noticed that the board is very much larger than the integrated circuit itself.

Since a full-scale computer consists of many thousands of these discrete circuit elements, it is obvious that the cumulative effect of the additional bulk required for each mounting component can have a profound influence on the final size of the machine.

The two basic problems which designers of the Elco Omni-Comb system were required to solve can therefore be summarised as:

1. Provide a system which enabled full use to be made of the miniaturisation characteristics of integrated circuits.
2. Ensure that the system could be quickly assembled by unskilled labour, and be suitable for small batches or quantity production.

The system which they ultimately proposed seems to provide the answer to these requirements.

The mounting components of the Elco Omni-Comb system comprise five basic parts, as illustrated in figure 1. These are:

(A) CARRIER. This is a moulded plastic housing measuring 4in x 1in, with slotted walls into which are fitted the flat packs, interconnecting media and external contact assemblies. Each carrier has two bays which will hold 10 flat packs, placed end to end.

(B) OMNI-COMB. These provide the interconnection between flat packs in any one row. They are constructed from copper or kovar, and consist of a central flat bus bar with teeth attached to both edges, and are backed by an insulating strip. The spacing of the teeth conforms to the standard .05in centres used for flat pack leads. When unwanted teeth are cut away and the remaining teeth folded at right angles, the combs can be stacked inside the carrier in layers, to provide the required number of common buses.

(C) RETAINING CLIP. This device keeps the integrated circuit packs in the carrier and exerts sideways pressure on the flat pack leads and comb teeth to ensure good electrical contact.

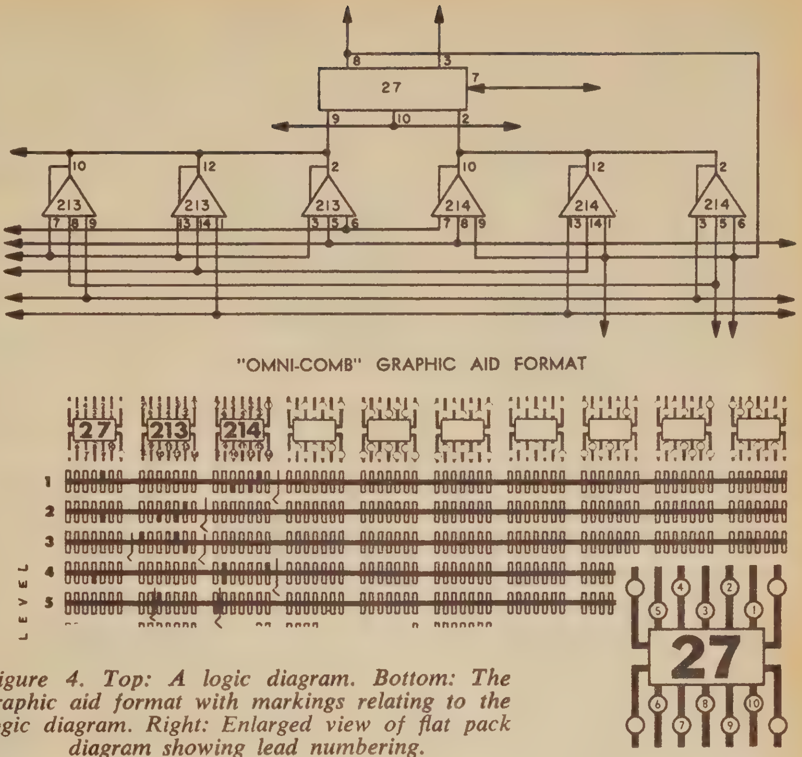

Figure 4. Top: A logic diagram. Bottom: The graphic aid format with markings relating to the logic diagram. Right: Enlarged view of flat pack diagram showing lead numbering.

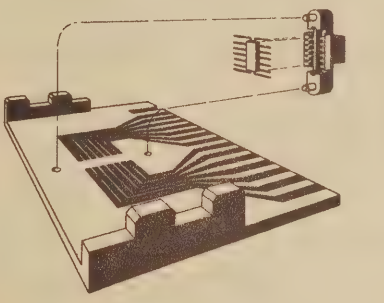

Figure 2 (above). A method of mounting individual flat packs on separate printed circuit boards.

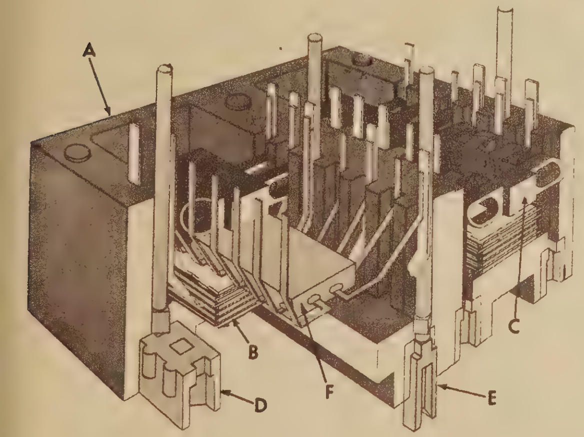

Figure 3 (left). Cross sectional view of Omni-Comb carrier, showing position of components and flat packs.

(D) EXTERNAL CONTACT INSULATOR. This is a plastic strip moulding having holes at .05in centres into which the external contact pins are fitted. The carriers have slots in the base and through-holes to allow the contact pins to mate with the flat pack leads and comb teeth.

(E) CONTACT PINS. See (D) above. These pins allow external connection, and connection between the two rows of flat packs in the same carrier.

It should be noted that the slots in the carriers, the comb teeth, the bars of the retaining clips and the spacing of holes in the external contact insulators are all based on the .05in standard lead spacing of the flat pack leads.

The enlarged view in figure 3 shows how all these components fit together to provide an interconnected system. The teeth of the comb layers (B) and the leads of the flat pack (E) fit into the slots in the wall of the carrier (A). The retaining clip (C) holds the assembly together and exerts pressure on the leads and teeth for good electrical contact. The external contact insulators (D) containing the contact pins (E) fit into slots in the base of the carrier. The contact pins pass through holes in the base of the carrier and make contact with the comb teeth.

The components are supplied in kits from which complete sub-assemblies can be constructed. In addition to the components already described, each kit is supplied with a kit of tools required for cutting the combs and shaping flat pack leads and comb teeth.

Obviously, a designer who intends to use the Omni-Comb concept should design his logic layout for compatibility with the system's physical features. To assist designers to think along the right lines during the early design stages, Elco has prepared a "graphic aid format" which will simplify the translation of the design layout into a finished Omni-Comb pack.

Figure 4 shows how this is done. At the top is the logic diagram, showing the integrated circuit flat packs to be used (triangles and rectangle). The numerals inside the triangles and the rectangles are the identification numbers of particular flat packs. The three triangles numbered 213 represent one flat pack, similarly the three triangles numbered 214.

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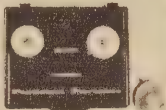

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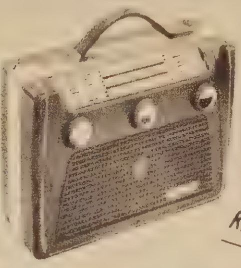

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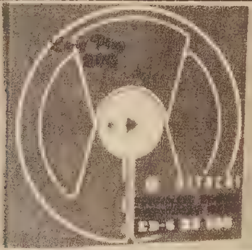

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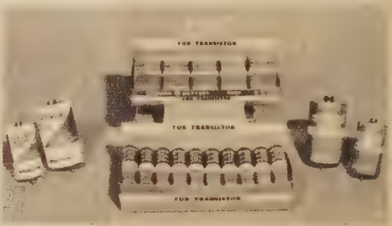

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								1,100 c/s (db)	7,000 c/s (db)				
50 υ	Less than 53	¼ (6.25 ± 0.05)	2/10	There must be no adhesion	30 or less	+1 −8	Less than 10	±1	+2 −3	2 or less	50 or more	65 or more	48 or more
35 υ	Less than 38												
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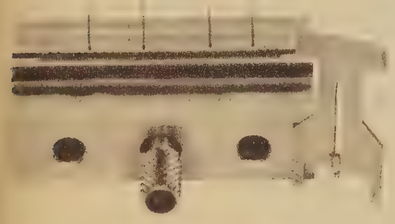
Underneath the logic diagram is the format. At the top of this are symbolic representations of the flat packs, 10 in number, and therefore corresponding to one complete row in one bay of a container. Each of the leads is identified by number and it will be noted that flat pack 27 is a 10-lead component (see enlarged diagram at side), while 213 and 214 are 14-lead packs.

Underneath again are the diagrams representing the combs, with full complement of teeth. Only five rows are shown, for space reasons, but up to 14 combs can be used with each row of flat packs. It is now an easy matter to identify the leads of the flat packs, and by reference to the logic diagram determine the desired interconnection points. It will be noted that a one-to-one relationship exists between the comb outline and the flat pack outline, so the tooth/lead combinations which will make the required connections can be identified without difficulty. The teeth which are to be retained to allow interconnection are filled in on the diagram.


Top. This special jig is used for mounting the contact pins into the external contact insulator and locking them in position. Right. Loaded external contact insulators, and carrier with insulator strips inserted. Epoxy or cement is applied for permanent assembly.

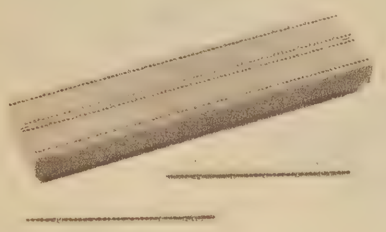
A study of the integrated circuit leads shown in the logic diagram and the way these have been translated in the graphic aid format should make the process quite clear. For example, lead 8 in integrated circuit 27 is commoned with pins 1, 6, and 9 of circuit 214. These connections are provided in comb number 4, so the teeth corresponding to the appropriate leads are marked in comb number 4 to indicate that these teeth are to be retained. The unmarked teeth will be cut off.

Having marked all the necessary interconnections on one lead path, further paths, representing additional layers of combs, are dealt with in the same way, until all interconnection requirements have been satisfied. Since it would be wasteful to use a whole comb for only a few interconnections, provision is made for cutting the comb at appropriate points, so that a section of it can be commoned, but more than one common lead can be accommodated on the whole comb length.

Elco recommends that designers should regard one format sheet as the equivalent of one complete row of a comb holder, that is to say that each sheet will show connections for up to 10 flat packs and up to 14 comb lengths. Since two rows of flat packs can be housed in one carrier, which may need to be interconnected, circuitry between rows can be minimised by careful positioning of integrated circuits.

With the final arrangement of the integrated circuits and interconnections decided, the actual physical assembly can be undertaken. The first step is cutting the comb bus line, then the unwanted teeth are removed. Hand punches are provided for both operations, and figure 4 shows a cut-away section of these punches. It should be noted that when the punch cuts the bus line, it leaves the insulated backing intact at the edges, so that the comb remains in one continuous length. All teeth not marked on the graphic aid format are removed.

When the hand punch is used, the combs must be positioned by hand under the cutting blade, but guide marks on the tool head assist in locating the comb correctly. For quantity production, a master programmed punch has been designed. This uses a program card which has die cut holes corresponding to the comb teeth. In use, it is only necessary to push out the centres of the holes corresponding to the teeth to be retained, insert the card in the reader station, and start the machine. All unwanted teeth will then be automatically removed from combs fed to the machine.



Suitable forming jigs are used to fold the teeth to the correct shape for inserting them into the carriers. The leads of the flat packs are treated in the same way.

The finished comb sections can then be loaded into the carriers. Up to 14 comb layers can be accommodated in each carrier, but the manufacturers say that most interconnecting schemes can be satisfied with about eight layers. Now the flat packs can be added, while checking location against the graphic aid format. To assist in correct placement, the positions to be occupied by separate flat packs are indicated by raised bosses on the carrier body. With all flat packs in position, the retaining clips are inserted to hold the assembly intact.

The contact pins can now be positioned in the external contact insulator strips, to provide for all necessary external connections. A separate strip is prepared for each of the four rows of contacts in each carrier. The graphic aid format shows which leads have external connections, and pins are inserted in the strips in the positions corresponding to these leads. When positioned in the strip, the pins are locked by a slight twisting motion. When fully assembled, the insulator strips are inserted in the appropriate slots in the base of the carrier.

This completes the assembly of one complete carrier unit, and after testing it can be mounted in position in the equipment under construction. A printed circuit sub-assembly containing a number of complete carriers is suggested by the makers as a convenient method of mounting. This would have punched holes for location of the contact pins, and printed circuitry for the required circuit connections.

It will be seen that the system lends itself readily to factory assembly procedures, since assembly can be reduced to a number of simple operations which can be undertaken by artisan labour. Once the form of assembly has been decided the comb-cutting process is the only factor in manufacturing which has to be varied, and this operation can be delegated to the master programmed punch. Assembly and placement of the components in the right order can be ensured by production line technique.

Automated manufacture is also quite feasible, since the whole assembly process can be reduced to separate simple steps which can be programmed for execution by relatively simple equipment. Another big advantage is that permanent connection, when required, can be effected by dip soldering the leads protruding from the tops of the carriers.

The system would also appear to be a valuable training aid to universities, technological institutes and research laboratories, since the Omni-Comb components allow the construction of logic layouts directly from design data, without intermediate development work. ■

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2N3638	General purpose	—25V	65 @ 150mA; —10V	-.25V @ 150mA	200Mc	.75	.50
2N3638A	General purpose	—25V	110 @ 150mA; —10V	—.25V @ 150mA	200Mc	.90	.60
2N3639	High Speed switch	— 6V	63 @ 10mA; —.3V	—.16V @ 10mA	750Mc	.75	.50
2N3640	High Speed switch	—12V	63 @ 10mA; —.3V	—.2V @ 10mA	750Mc	.84	.56
AY1102	RF amplifier	—15V	75 @ 10mA; —3V	—.2V @ 10mA	750Mc	.93	.61
AY1104	High current amplifier	—30V	70 @ 250mA; —1V	—.1V @ 300mA	200Mc	1.10	.73
AY1106	High current amplifier	—20V	60 @ 250mA; —1V	—.1V @ 300mA	200Mc	.99	.66
AY1110	Low noise amplifier	—25V	120 @ 10mA; —10V	—.25V @ 50mA	200Mc	1.25	.83

*Add 25% tax where applicable.

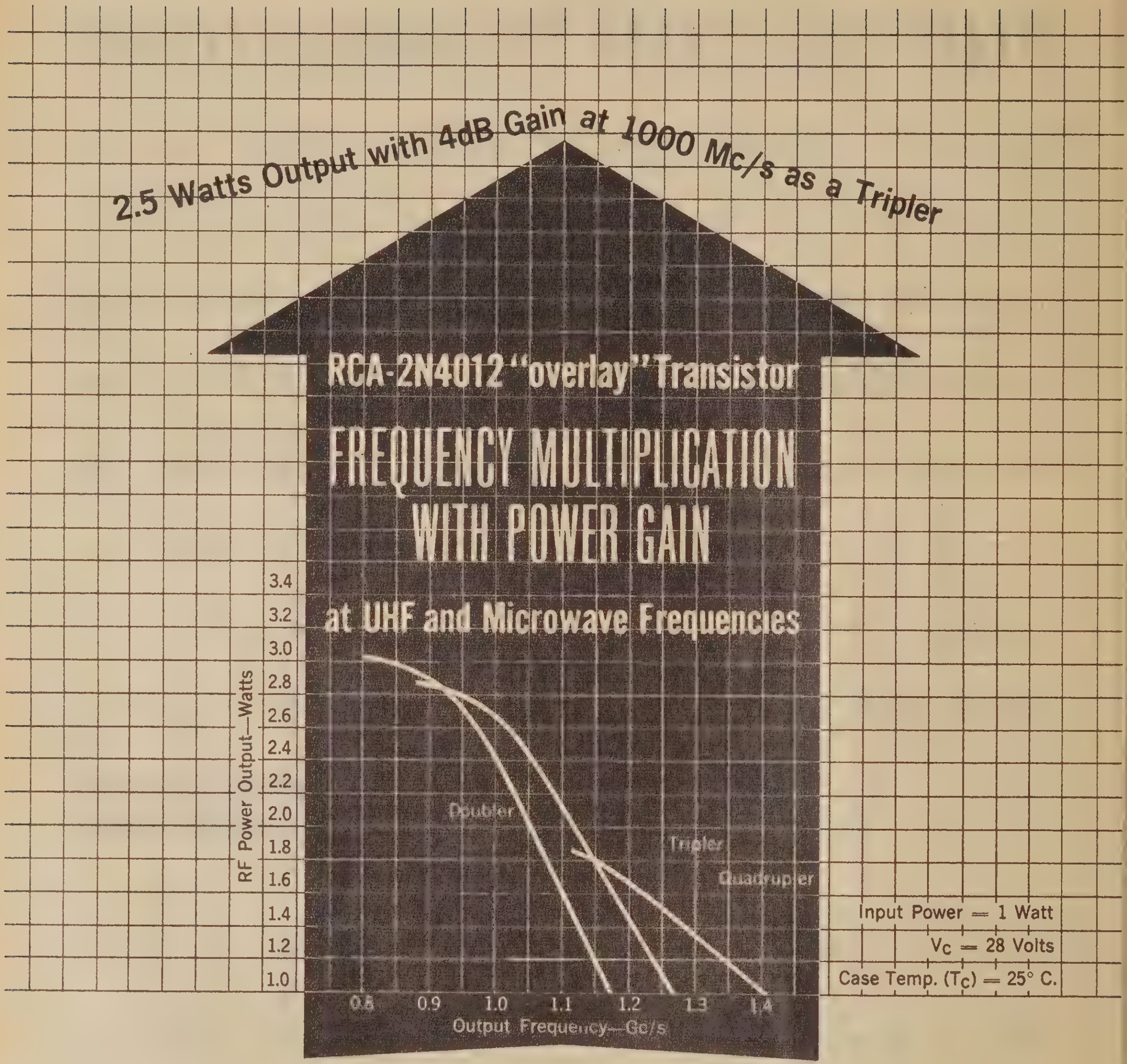
FC7

2.5 Watts Output with 4dB Gain at 1000 Mc/s as a Tripler

RCA-2N4012 "overlay" Transistor

FREQUENCY MULTIPLICATION WITH POWER GAIN

at UHF and Microwave Frequencies



Now for the first time, you can achieve frequency multiplication with power gain at microwave frequencies with a single solid-state device, the new 2N4012 silicon transistor. With this new "overlay" unit, you can greatly simplify circuit design as well as reduce costs. At 1 Gc/s, one single 2N4012 can replace both the transistor power amplifier and varactor diode stages previously required.

Offering frequency multiplication with power gain in the 1 Gc/s region, the 2N4012 as a doubler, tripler, and even as a quadrupler, extends transistor performance into the microwave region with watts of power! When used in a common-emitter configuration, this transistor provides stable operation—power output varies smoothly with changes in power input.

Find out how the 2N4012 can help you cut costs by eliminating the varactor and reduce the size of hardware in space, military, and commercial applications. For technical data, price, and delivery, contact Amalgamated Wireless Valve Co. Pty. Ltd., 348 Victoria Road, Rydalmere, N.S.W., or any interstate office.

	2N4012 DOUBLER	2N4012 TRIPLER	
Output Power	3 (typ)	2.5 (min)	Watts
Output Frequency	800	1002	Mc/s
Input Frequency	400	334	Mc/s
Conversion Gain	4.8 (typ)	4 (min)	dB
MAXIMUM RATINGS	V_{CBO} 65 Volts V_{CEO} 40 Volts V_{CEV} 65 Volts V_{EBO} 4 Volts I_C 1.5 Amperes		

AWV

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PLAYMASTER 112 TRANSISTOR CONTROL UNIT — addendum

Some additional information on the silicon transistorised "Playmaster 112" Control Unit, described in the December issue. Diagrams to aid constructors in building "magnetic pickup" or "crystal pickup" versions, together with details of a small AC mains power supply.

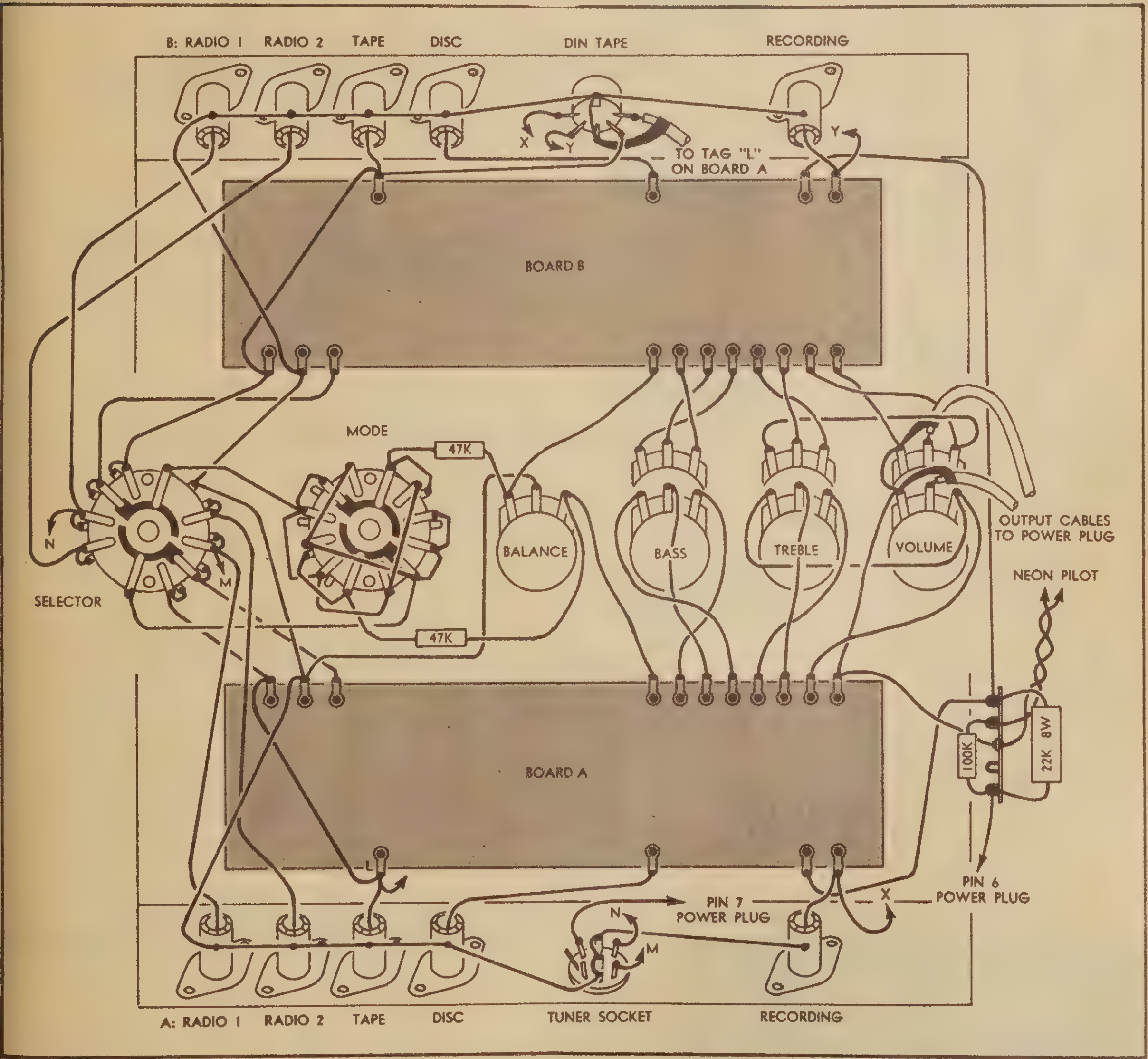
FOLLOWING the publication of details of our new "Playmaster 112" Control Unit last December we have received a small number of letters from readers who were interested in the project but were unsure whether it could be adapted to their requirements. Most of the readers expressed difficulty in interpreting our diagrams to find out how they could build up simple units equivalent to our valve-type "crystal" and "magnetic" Control Units. •

It is in fact quite a simple matter to build up "crystal pickup" or "magnetic pickup" versions of the design, as the diagrams were intended to convey. However to make the position clearer, we are presenting here both the main wiring diagram and the appropriate board wiring diagrams for such versions.

Below is the main wiring diagram; this shows how the two printed wiring boards are connected to the controls and connectors, etc. It applies in both cases—"crystal pickup" and "magnetic pickup" versions will differ only in the wiring of components on the boards.

This diagram is identical with that shown on page 51 of the original article apart from the wire links replacing the tape preamps. The links convert the "tape" position of the selector switch into a third 500mV/100K flat or "radio" input.

The wiring for the boards is shown in the diagrams overleaf. As before, only the wiring for board "A" is shown, due to lack of space; board "B" is simply a lateral mirror image. The diagram at the top of the page shows how the boards are wired for a "crystal pickup" Control Unit, while the diagram in the centre


B: RADIO 1
RADIO 2
TAPE
DISC
DIN TAPE
RECORDING
X
Y
TO TAG "L" ON BOARD A
Y
BOARD B
MODE
47K
SELECTOR
N
M
BALANCE
BASS
TREBLE
VOLUME
OUTPUT CABLES TO POWER PLUG
NEON PILOT
47K
BOARD A
100K
22K 8W
L
PIN 7 POWER PLUG
N
M
X
PIN 6 POWER PLUG
A: RADIO 1
RADIO 2
TAPE
DISC
TUNER SOCKET
RECORDING

HIGHLIGHTS *FROM THE NEW*

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TRANSFORMERS A&R MELB. AUST.

STOCK TRANSFORMER CATALOGUE

PAGE 8

TRANSFORMERS for use with BRIDGE TYPE CONTACT COOLED SELENIUM RECTIFIERS

The use of a Bridge type Transformer together with a contact cooled rectifier and filter capacitor produces a very compact low cost power supply.

PAGE 9

VERSATILE NEW RANGE FILAMENT and LOW VOLTAGE POWER SUPPLY TRANSFORMERS

Includes Universal Filament Transformers. T.V. Picture Tube Boosters, Battery Charger and Transistor Power Supply Transformers.

PAGE 11

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PAGE 15

TRANSFORMERS SUITABLE FOR TRANSISTOR APPLICATIONS

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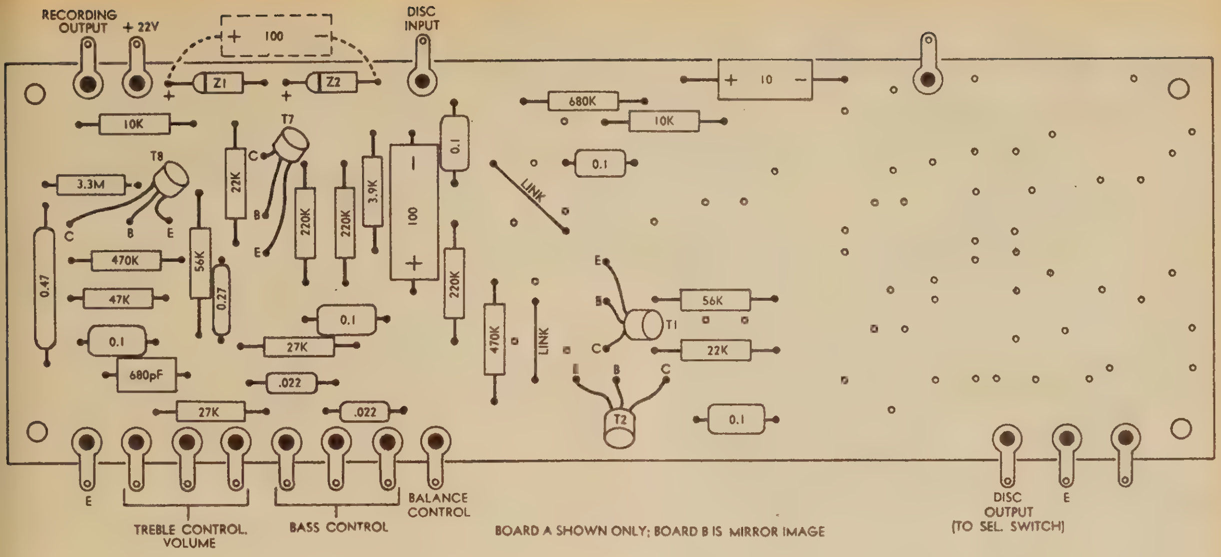
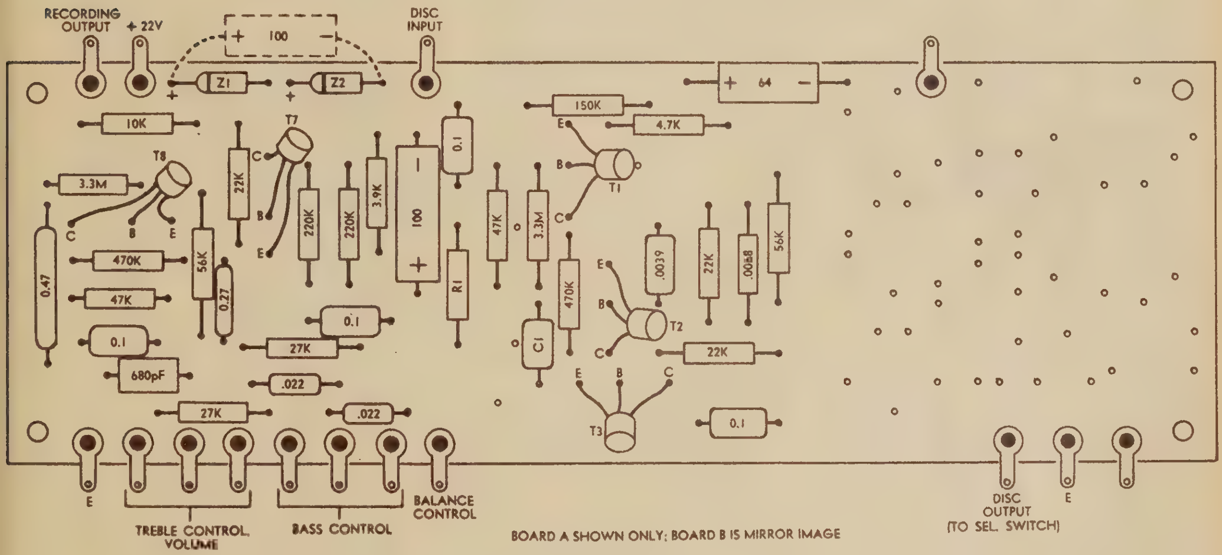

RECORDING OUTPUT
+ 22V
100
DISC INPUT
Z1
Z2
10
680K
10K
T7
T8
3.3M
22K
0.1
LINK
0.47
470K
47K
56K
0.27
220K
220K
3.9K
100
220K
470K
56K
T1
22K
T2
680pF
27K
.022
27K
.022
E
TREBLE CONTROL. VOLUME
BASS CONTROL
BALANCE CONTROL
BOARD A SHOWN ONLY; BOARD B IS MIRROR IMAGE
DISC OUTPUT (TO SEL. SWITCH)
E

Above is the board wiring required for a "crystal" Control Unit.


RECORDING OUTPUT
+ 22V
100
DISC INPUT
Z1
Z2
64
150K
4.7K
10K
T7
T8
T1
3.3M
22K
0.1
0.47
470K
47K
56K
0.27
220K
220K
3.9K
100
R1
47K
3.3M
C1
470K
.0039
22K
.0068
56K
T2
22K
T3
680pF
27K
.022
27K
.022
E
TREBLE CONTROL. VOLUME
BASS CONTROL
BALANCE CONTROL
BOARD A SHOWN ONLY; BOARD B IS MIRROR IMAGE
DISC OUTPUT (TO SEL. SWITCH)
E

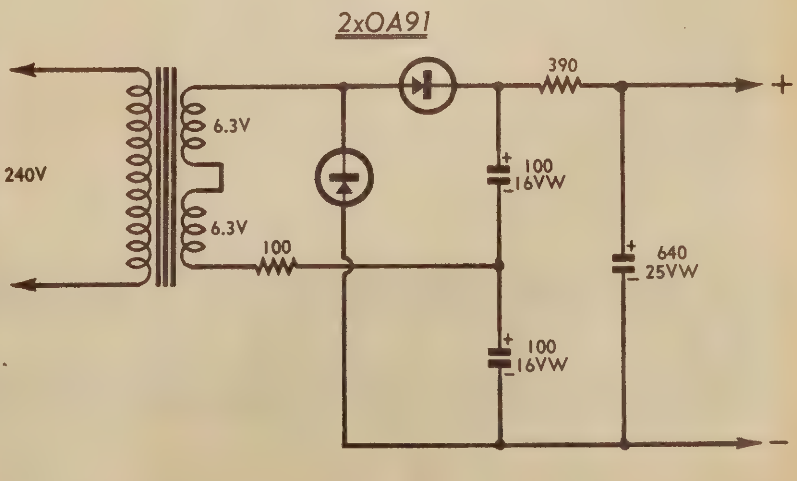
To wire up a "magnetic" Control Unit, use this diagram instead.

shows how they are wired for a "magnetic pickup" Control Unit.

For those who may desire to operate the Control Unit (any version) from the AC mains rather than from the main amplifier HT line, we show at right the circuit of a small power supply which is suitable for this purpose. It should be built into an external case to prevent transformer radiation from inducing hum into the Control Unit wiring and metalwork. When using this supply the zener diodes Z1 and Z2 should be **retained** in the Control Unit, while the 22K 8-watt resistor should be **omitted.**

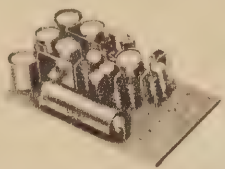
The diodes used in this supply may be OA91's or any similar type with a PIV of 30V or more and a direct current rating of more than 10mA. The 100 ohm resistor limits the surge current to a safe value.

Finally, please note that there was an error in the original parts list for this project (p. 57): "Disc Preamp A" contains only **one** .0068uF capacitor, not seven! (J.R.) ■


2xOA91
240V
6.3V
6.3V
100
390
+
100 16VW
640 25VW
100 16VW
−

The circuit for a small external power supply suitable for operating the Control Unit from the AC mains.

Tested, off-the-shelf amplifiers for any application



Newmarket pre-assembled Packaged Circuit Amplifiers have been developed to provide standardised starting points in the design of all types of equipment in which amplifiers fulfil a major role. Six are at present available from stock and others are in course of development. Their use saves expensive, time-consuming research, thus cheapening the production of new types of electronic equipment.

Recently released is the PC9 impedance matching A.F. pre-amplifier. It has been specifically designed to enable a high impedance capacitive source to be fed into the relatively low impedance amplifiers PC2, PC3, PC5 and PC7+. An abridged specification is listed below.

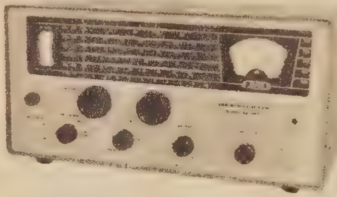
SUPPLY VOLTAGE: 9V.
INPUT IMPEDANCE: Typically 600 ohms.
FREQUENCY RESPONSE: Flat from 20 cps to 20 kc/s (± 3db) at 1 kc/s level.
SIZE: 1.4" x 1.25" x .5". WEIGHT: 7 grams. **Price: £3/5/-**

SPECIFICATION DETAILS

A typical miniature Audio-Amplifier is illustrated actual size above. Circuits are of transformerless, complementary symmetry type, operating off Standard Voltages. Can be wire-in or plug-in as required.

PERFORMANCE DATA	PC1	PC2	PC3	PC4	PC5+	PC7+
Power Output (RMS)	150mW	400mW	400mW	400mW	3W	0.8W
Input Sensitivity (Full output)	100mV	2mV	10mV	200mV	5mV	5mV
Input Impedance (Typical)	1.5K	1K	2.5K	220K	1.5K	1.5K
Load Resistance (Ohms)	40	15	15	15	3	8
Supply Voltage (Nominal)	9V	9V	9V	9V	12V	9V
Total Distortion (Full output)	6%	6%	6%	6%	3%	3%
Frequency Response	330 c/s —15Kc/s	200 c/s —12Kc/s	200 c/s —12Kc/s	200 c/s —12Kc/s	50 c/s —15Kc/s	50 c/s —15Kc/s
Overall Dimensions (Inches) All ¾in. high.	2 x 1	2½ x 1½	2½ x 1½	2½ x 1½	5½ x 1¾	3 x 1¾
PRICE	**£3/2/6**	**£3/15/**	**£3/15/**	**£3/15/**	**£8**	**£4/15/**

PALACE MODEL HCR-62 PROFESSIONAL QUALITY 4-BAND AMATEUR COMMUNICATION RECEIVER



£62/10/- plus sales tax

PALACE HCR-62 is one of the world's most advanced Amateur Communication Receivers designed and manufactured to meet the exacting requirements of amateurs in this advanced electronic age. The bandset and bandspread dials are fitted with large fly-wheels for smooth tuning with minimum back-lash. One RF stage and two IF stages ensure high sensitivity and selectivity. Excellent selectivity has been achieved by the use of back-to-back intermediate frequency transformers in the IF amplifier stages. The vertical S meter is connected in a bridge circuit which maintains stable operation.

Special terminals are provided on the rear chassis for connection of a Q5er for double superhet action. The output frequency of this connection is 455KC.

SPECIFICATIONS:
FREQUENCY RANGE:

Band 1	540-1605 KC
Band 2	1.6-4.8 MC
Band 3	4.8-14.5 MC
Band 4	10.5-30 MC

BAND SPREAD:

3.5 MC Band	3.5-3.575 MC
7 MC Band	7.0-7.14 MC
14 MC Band	14.0-15.2 MC
21 MC Band	21.0-21.9 MC
28 MC Band	28.0-30.2 MC

CONTROLS:

1. AF Gain (Volume Control) with Power-Off Switch.
2. Function Switch (Manual Volume Control, Automatic Volume Control, and CW-SSB)
3. Main Tuning.
4. Band Spreader.
5. B.F.O. Pitch Control.
6. A.N.L. (Automatic Noise Limitor) (On-Off.
7. Sensitivity Control (for gain control on R.F. and I.F. Amplitude)
8. Band Selector (4 bands position)
9. Receive-Standby Switch.
10. S-Meter Zero Adjuster.
11. Headphone Jack.

SELECTIVITY:—60 dB at ± 7 KC detuning.
SENSITIVITY: 3 uV (S/N 20dB at 10 MC)
TUBE COMPLEMENTS: 6BA6 x 4, 6BE6 x 1, 6AL5 x 1, 12AT7 x 1, 6AR5 x 1, 5Y3GT x 1.
SIZE: 17" (W) x 8½" (H) x 10-3/4" (D)
WEIGHT: 26 lbs.

MODEL DH-100 EXTENSION SPEAKER FOR HCR-62 RECEIVER

DH-100 is specially designed desk/wall-hang type speaker matching with HCR-62 Communication Receiver. Minutely finished rugged metal housing with pipe stand, assuring rich tone and power.

SPECIFICATIONS:
OUTPUT POWER (max.): 3W
FREQUENCY RESPONSE: 250-6000 c.p.s.
VOICE COIL IMPEDANCE: 4 ohm.
SIZE: 5-1/4" (Dia.) x 5-½" (Depth).
WEIGHT: 1.5 lbs.

MODEL No. PC 1
Stethoscope Amplifier.
General Purpose Audio Amplifiers and Drivers.
Intercomm Amplifier.
Telephone Amplifiers.
Laboratory Instrument Amplifiers.
Back Projector Audio Amplifiers.
Loudspeaker Amplifier.
Hospital Board Control Units Intercomm Amplifiers.

MODEL No. PC 2
Modulator Driver Stage.
Intercomm.
Church Hearing Aid Amplifier.
Office Dictating Machines.
Door-Caller Monitor Amplifier.
Inter-Office Communication Amplifier.
Tape Replay Amplifier.
General Purpose Audio Amplifiers and Drivers.
Telemetry Audio Amplifier.
Radio Receiver Audio Amplifier.
Telephone Amplifiers.
Educational Equipment Audio Amplifiers.
Laboratory Instrument Amplifiers.
Language Laboratory Amplifiers.
Tape Recording Amplifiers.
TV Aerial Riggers Intercomm Amplifier.
Loudspeaker Amplifier.
Radio Concentrator.
Mine Communication Amplifier.

MODEL No. PC 3
Disc Talking Book.
DC Relay Driver.
Telecommunications Conference Monitor Amplifier.
Sound-level Meter Amplifier.
Close Background Music Amplifier.
Sound Reinforcement Amplifier.
General Purpose Audio Amplifiers and Drivers.
Low Power Battery Stereo.
VHF Communications Receiver Audio Amplifier.
Radio Receiver Audio Amplifier.
Radio Relay System Amplifier.
Loudspeaker Amplifier.

MODEL No. PC 4
Battery Record Player.
General Purpose Amplifiers and Drivers.
Office Dictating Machines.
Telephone Amplifiers.
Pay TV Control Circuits Amplifier.
Stereo Listening Booth Amplifiers.
Laboratory Instruments Amplifiers.

MODEL No. PC 5 Plus
Salesman's Portable Cine Projector Audio Amp.
Meter Type Galvanometer Amplifier.
Helmet Intercomms: (a) Diving Suits. (b) Crash Helmets. (c) Pilots' Helmets.
Car Radio Audio Amplifier.
Communications Receiver Audio Amplifier.
Lecturer Non-interruption Monitor.
Erotogenic Amplifier.
Small public Address Portable Amplifier.
Servo Amplifier (Hydraulic valve control).
General Purpose Amplifier.
Fault Finding Tone Detector Amplifier.
Tape Replay Amplifier (Aircraft ground equipment).
Automation Drive Amplifiers.
Colour Television Receiver Audio Amplifier.
Tape Recorder Replay Amplifier.
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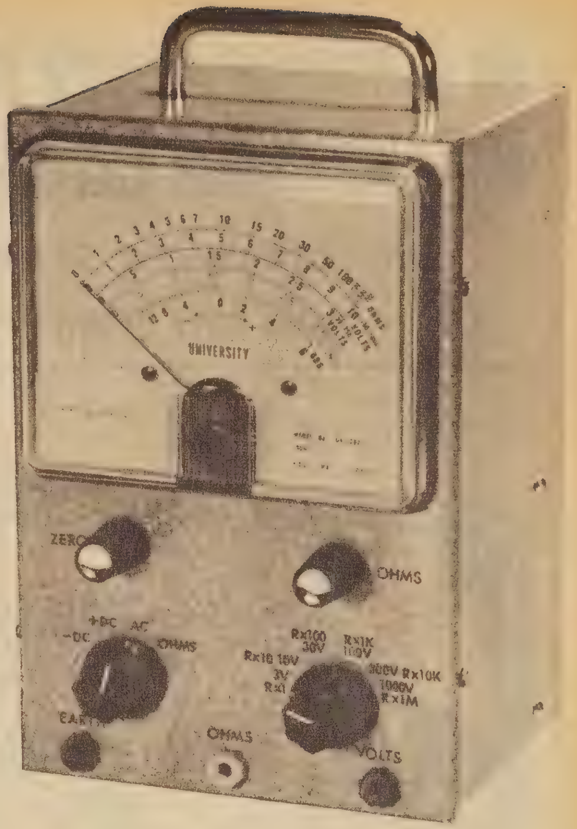
Our new Vacuum Tube Volt Meter should prove to be a popular item. It performs all the functions at least equally as well as its predecessors, notwithstanding the fact that it is the simplest and least expensive which we have produced in this field.

By Ian Pogson



This front view shows the convenient disposition of the meter, controls and input sockets.

For some time, we had been considering the idea of presenting a simple and compact type of VTVM, even to the point of sacrificing something in the way of performance in the interest of simplicity. In the past, from when the first instrument was described in 1949, together with the Senior VTVM in January, 1956 and the Bench Type unit in January, 1959, all have more or less of necessity been rather complex in design. Moreover, the size was not as small as we would have liked.

While there is no denying the advantages of a VTVM compared with a multimeter, in making measurements in high impedance circuits, the problems of stability and contact potential effects have always presented a challenge to the ingenuity of the designer of VTVM circuits. If these points are neglected by the designer, the effect on the patience of the user can hardly be over emphasised.

In approaching our new VTVM, certain basic requirements were laid down as a starting point. It should be housed in a small case, preferably one of our standard types. The meter and scale would be the same as that used on previous models. It naturally followed from this decision, that the same ranges as previously would be incorporated. Switching should also be arranged to perform the necessary functions but complex switching should be avoided. Last but not least, the cost should be kept down to a minimum.

This specification is rather a stringent one, but a glance at the circuit and photographs of the unit will indicate that we have had at least a good measure of success. In fact, with modern valves and techniques at our disposal, we have been able to develop an instrument which is simplicity itself but performs at least as well as previous complicated designs.

The 6CG7 valve, which was also used in the Bench Type VTVM, contributes to the success of the instrument. Contact potential and its problems have been substantially reduced in the design of this valve. This is borne out by the fact that on the 3-volt DC ranges, the amount of zero error amounts to something of the order of 25 millivolts which for most purposes, is of little consequence.

Contact potential on the 6AL5 rectifier, makes its presence felt on the AC ranges, being worst on the 3-volt range and becoming progressively less on higher ranges. This may be corrected by simply adjusting the "zero" control after selecting the required range. This is effective but is inconvenient to say the least. This problem has been completely eliminated by incorporating a special "bucking" circuit. A small positive potential is fed to the plate of the 6AL5 retifier, to cancel the negative contact potential.

This bucking potential is obtained from the positive side of the HT power supply, via a 100K resistor and a 20K potentiometer. The rotor of the potentiometer which provides a source of variable voltage, is fed via three 22M resistors and the other half of the 6AL5 in series, into the AC voltage divider network. The high value of isolating resistance (66M) is necessary to avoid serious shunting of the voltage divider which would upset the proper operation of this circuit.

With this arrangement, it is possible to switch from the 3-volt to the 1000-volt ranges without any change in the zero setting. The second half of the 6AL5 is connected in series with the bucking circuit to afford some measure of stabilising of the zero adjustment which may tend to change due to aging of the AC rectifier section of the 6AL5.

The scales on the meter are arranged in the ratio of 3 to 10 and in order to provide a dB scale, it is necessary to make the "3" scale 0.954 of the length of the "10" scale. Then, by changing between any two adjacent ranges, a step of 10dB is affected. This arrangement then calls for some sort of compensation of the voltage taken off the divider stick to the grid of the 6CG7, such that the correct reading will be given on the meter. A ratio of 109.5 to 34.5 meets this requirement and the values for each section of the divider can be obtained with combinations of preferred values of resistors, with little if any error.

In the past, it was common practice to introduce compensating resistors into the system and switch them alternately with the range selector switch. This method is perfectly all right, but it calls for an extra wafer on the switch. So by changing the resistor values as described, the switching is made that much simpler.

While we are on the subject of the voltage divider, here is how we have obtained the rather odd resistance values. The 7.5M resistance at the top is made up with a 3.3M, a 1.5M and a 2.7M in series. This value could have been obtained by putting in parallel, two 15M resistors. However, as there can be a maximum of 700 volts applied across this section, the maximum voltage rating of the resistors would be exceeded. By splitting up the voltage between three resistors, the voltage across each resistor is still within the rated limits.

The 2.35M resistor is made up with two 4.7M units in parallel. As the maximum voltage to appear across this section is only 200 volts, there is no rating problem here. The 750K resistor consists of a 680K and a 68K in series. This actually adds up to 748K, the error being about 0.27 per cent, which can be safely tolerated. The next value of 235K is made up by putting two

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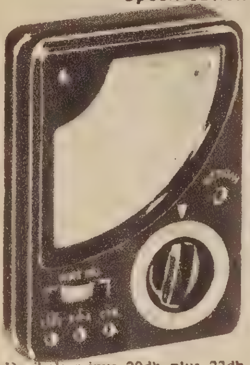
MODEL 200H

20,000 Ohms per Volt DC 10,000 Ohms per Volt AC.

Specifications:



DC Volt: 0-5, 0-25, 0-50, 0-250, 0-500, 0-2,500.

AC Volt: 0-10, 0-50, 0-100, 0-500, 0-1,000

DC Current: 0-50, Micro-amps res 0-25, 0-250 Milliamperes.

Resistance: 0-60K Ohms, 0-6 Meg Ohms.

Capacity: 0-01-0.3mfd (at AC 5 volt 0.0001-01mfd at AC 250 Volt).

Decibel: minus 20db plus 22db.
Output Range: 0-10, 0-50, 0-100, 0-500, 0-1,000
Battery used: UM-3-1, 1 piece.
Dimensions: 3¼in x 4½in x 1⅛in.
Complete with internal battery, testing leads and prods.

PRICE: £5/10/-
Including Sales Tax
Plus Postage 3/6.

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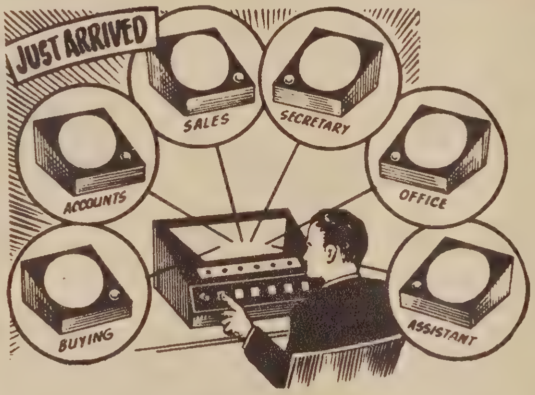

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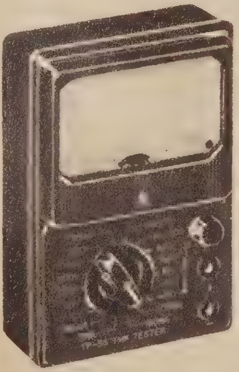
4 Station 1 Master 3 Sub-stations 6 x 1½V Batts., from **£12.**
5 Station 1 Master 4 Sub-stations 6 x 1½V Batts., **£22/7/9.**
7 Station 1 Master 6 Sub-stations 6 x 1½V Batts., **£27.**

Plus Postage.

MODEL TP-5S

- High sensitivity-20,000 Ohms/V DC, 10,000 Ohms/V AC.
- 3in Meter.
- Handy pocketable size.

Specifications:



DC Voltages: 0-10-50-250-500-1,000 V (20,000 Ohms/V).
AC Voltages: 0-10-50-250-500-1,000 V (10,000 Ohms/V).
DC Current: 0-50uA, 0-5-50-500mA.
Resistance: 0-10K, 0-100K, 0-1 Meg, 0-10-Meg. (62 Ohms, 620 Ohms, 6.2K, 62K at centre scale.)
Capacitance: 0.0001uF-0.005-uF, 005uF-1uF
Decibels: minus 20db to plus 36db in 2 ranges.
Dimensions: 3½in x 5¼in x 1⅜in.
Weight: 15oz approx.
Complete with internal battery, testing leads with prods.

PRICE: £9
Including Sales Tax.
Plus Postage 3/6.

Capacitor Substitution Box, 1000 VW 31/-
Resistor Substitution Box, 1 Watt, Plus Post. 2/-. 33/9

TRANSISTOR AERIALS

4in extends to 27in	**15/**
5in extends to 39in	**17/**
6in extends to 43in	**14/**
6in extends to 32in	**10/**
6in extends to 28in	**9/6**
7in extends to 39in	**16/**
9in extends to 39in	**14/**
10in extends to 39in	**9/6**

Plus postage 1/6.

LMI Crystal Mic. with 3.5mm plug. **10/.** Post free.

Crystal and Magnetic Earphones, 2.5mm plug, **5/.** Post free.

Trans. Pri. 220, 240, 250, Sec. 218V Doubler at 270mA, 6.3V at 8 amps. **25/.** Plus postage 10/.

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Slide Rule Calculators, add, subtract, etc. to six figures. **6/6 ea.** Post free.

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100ft x 2¼in	**4/6.**	**Post 1/**
300ft x 2¼in	**12/.**	**Post 1/**
1200ft x 5¾in	**25/.**	**Post 1/6**
1800ft x 7in	**39/6.**	**Post 2/6**

CRYSTAL SET BUILDERS

Coils	**6/-**
Diodes	**3/-**
Headphones	**25/-**
Tuning Conds.	**16/6**
Terms.	**1/- ea.**

1 Trans. Amplifier for crystal set circuit supplied,

Only 19/6
Plus Postage 2/6.

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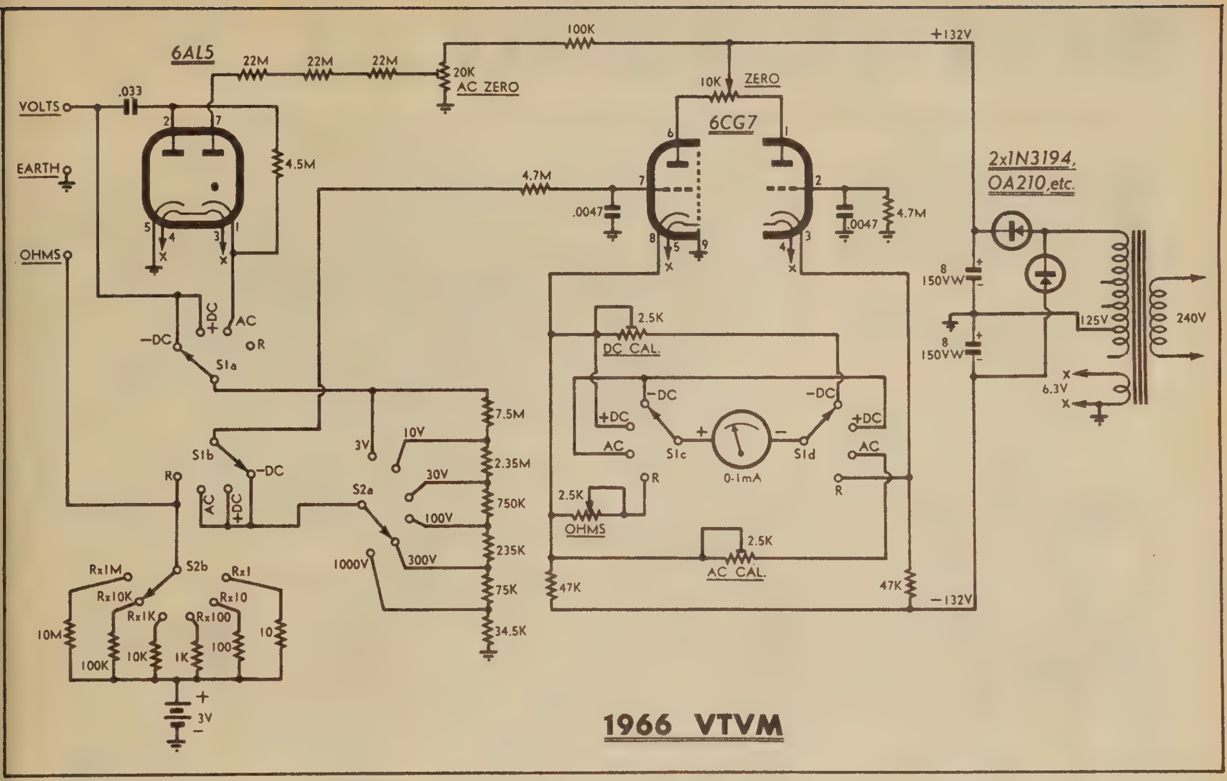

This circuit is perhaps the simplest of all the vacuum tube voltmeters which we have produced. The text should be studied to see how the odd values of the resistors in the voltage divider are obtained.

470K resistors in parallel. The 75K consists of two 150K units in parallel. Finally, the resistance of 34.5K at the bottom of the divider is made up by connecting in series, a 33K and a 1.5K.

Still on the subject of resistors, the 4.5M resistance on the 6AL5 rectifier, consists of a 3.3M and a 1.2M in series. The six resistors for the ohms-measuring ranges are all standard values and are readily obtainable.

The accuracy of all 24 ranges, DC+, DC−, AC and Ohms, depends to a large extent on the accuracy of all the resistors involved in the AC and DC voltage divided networks and the ohms reference resistors. The ideal way out of this is to use 1 per cent high stability resistors and in point of fact, this little instrument is worthy of this type of resistor with the best possible accuracy being assured. This involves the purchase of 21 resistors to make up all the needed values, and the cost of these items alone would amount to something of the order of $6 or £3 in the old familiar currency.

As a more economical alternative, it is possible to use a set of more or less ordinary resistors, which would cost about one third of the price for the high stability types. Resistors are available in at least one brand, which are of the deposited carbon type in 5 per cent tolerance, up to and including 1.2 megohms. Experience has shown that these resistors are generally well within the 5 per cent, which makes them quite an attractive proposition. Above 1.2M, they revert to the normal carbon structure and the tolerance is 10 per cent for these. Even so, these resistors are of good quality and may be used if the highest accuracy is not of prime importance. We might add that if you use these resistors, it would be a good idea to use all one watt units.

To add some strength to the case for the cheaper type of resistors, we have fitted our prototype with a set. Although individual builders may get varying orders of accuracy, our experience may be of use as a guide as to what may be reasonably expected. On the voltage

PARTS LIST

1	*Instrument case, 7½in x 5in x 4in with front panel.*
1	*Sub-chassis (L shape) 4-7/8in x 3-7/8in x 1½in.*
1	*Clamp, 3in x 1in.*
1	*Handle for case.*
1	*0-1 mA meter, 100 ohms, with VTVM scale.*
1	*Power transformer, 0-125V, 6.3V 0.9A.*
1	*Rotary switch, 2-section, 2-pole 4-positions per section.*
1	*Rotary switch, 2-section, 1-pole 6-positions per section.*
1	*6CG7 valve.*
1	*6AL5 valve.*
1	*9-pin ceramic valve socket.*
1	*7-pin ceramic valve socket.*
2	*silicon diodes, 1N3194, OA210.*

RESISTORS

10 per cent tolerance.

2	*47K 1W.*
1	*100K 1W.*
2	*4.7M ½W.*
3	*22M 1W or ½W.*

High Stability, Close Tolerance (see text).

1	*10M 1W or ½W.*
2	*4.7M 1W or ½W.*
1	*3.3M 1W.*
2	*2.7M 1W.*
1	*1.5M 1W.*
1	*1.2M 1W.*
1	*680K 1W or ½W.*
1	*68K 1W or ½W.*
2	*470K 1W. or ½W.*
2	*150K 1W or ½W.*
1	*100K 1W or ½W.*
1	*33K 1W or ½W.*
1	*10K 1W or ½W.*
1	*1.5K 1W or ½W.*
1	*1K 1W or ½W.*
1	*100 ohms 1W or ½W.*
1	*10 ohms 1W or ½W.*

POTENTIOMETERS

1	*10K wire wound or moulded carbon.*
1	*2.5K curve A.*
1	*20K curve A pre-set.*
2	*2.5K curve A pre-set.*

CAPACITORS

1	*.033uF 1500V paper or dipol.*
2	*.0047uF polystyrene.*
2	*8uF 150VW electrolytics.*

SUNDRIES

2	*Dry cells, 950 or similar.*
2	*Miniature tag-board strips, with 15 pairs of tags on each.*
1	*10-tag strip.*
1	*5-tag strip.*
3	*Banana sockets.*
2	*Banana plugs.*
2	*Test prods.*
8	*Rubber feet.*
4	*Knobs,*
	Power cord, 3-pin plug, hook-up wire, screws, etc.

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4 CHANNEL TRANSISTORISED MICROPHONE MIXER

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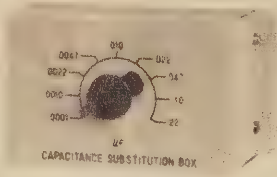
$9.60 (£4/16/0)



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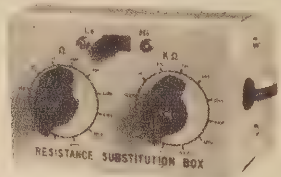

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Housed in all-metal box with a selection of 24 different values from 15 ohms to meg ohms complete with leads and insulated alligator clips.

Price $4.50) (45/-)

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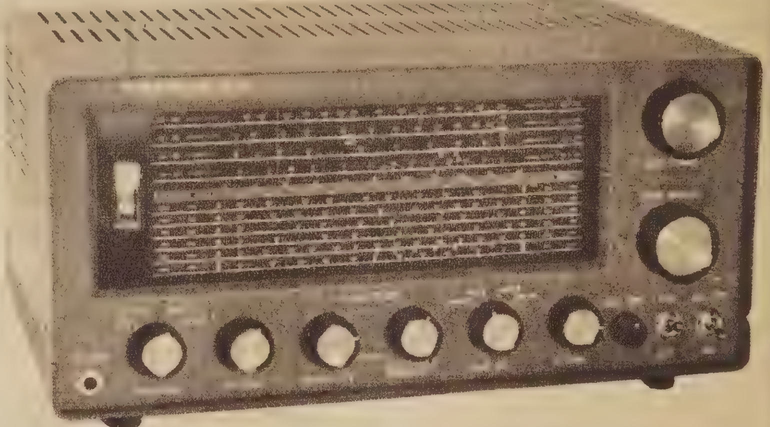
Monaural pre-amplifier can be used with any Hi-Fi amplifier not incorporating low level inputs for magnetic pick-ups or tape heads. RIAA equalisation is incorporated with a response of 30-20 000 C.P.S. uniform within 2 DB. Gain 40 DB Phone and 60 DB Tape. Output 1 volt at 100,000 ohms. All chrome chassis. Power supply 240V AC.

Price $10.50 (£5/5/-)



TRIO 9R-59 COMMUNICATIONS RECEIVER

FREQUENCY RANGE: 540-1605 K c/s, 1.6-4.8 M c/s, 4.8-14.5 M c/s, 10.5-30 M c/s.
BAND SPREAD: 3.5 M c/s, 7 M c/s, 14 M c/s, 21 M c/s 28 M c/s.
SENSITIVITY: 10 UC (Input at 10 M c/s), S/N Ratio equals 20 DB.
SELECTIVITY: Variable from - 93 DB to 60 DB (Q-MULT in Operation with plus or minus 10 KC Detuning).
OUTPUT: 1.5 Watt.
POWER: 240 AC, 50 VA.
TUBE COMPLEMENT: 6BA6 RF AMP; 6BE6 MIXER; 6BE6 LOCAL OSC; 2X6BA6 I.F. AMP; 6AV6 2 ND, DET, AF AMP and ANL 6AV6 Q'MULTIPLIER, BFO. 6AQ5 POWER OUTPUT. 5Y3 POWER RECTIFIER.
SPEAKER IMPEDANCE: 4 or 8 Ohms (Speaker not provided).
DIMENSIONS: Width 15 inches x Height 7 inches x Depth 10 inches.
WEIGHT: 20.5lbs.
AUX CIRCUITS: Band-Spread: Q-Multiplier: Automatic Noise Control.
AVC-MVC.
Phone Jack Plug.

PRICE **$139.00**

PRICE £69/10/.

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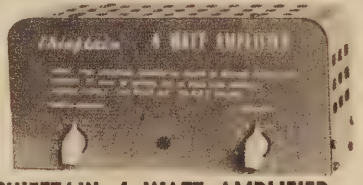
CHECKS ALL TYPES OF CONDENSERS FOR CAPACITY, LEAKAGE, OPEN SHORTS OR INTERMITTENT CONDITION. DIRECT READING SCALES FROM .00001 TO 1000 MFD AND 100-5 MEGOHMS.

A stable and accurate bridge type circuit measures CAPACITANCE in 4 RANGES of .00001-.005 MFD. .001-.5 MFD, 1-50 MFD and 20-1000 MFD. Two RESISTANCE RANGES of 100-50,000 and 10,000-5 MEGOHMS. Check LEAKAGE under actual load with choice of 25, 150, 250, 350 and 450 VOLTS available by selector switch. POWER FACTOR CONTROL from 0-50 p.c. Checks for LEAKAGE, OPEN, SHORT, OR INTERMITTENT operation. All readings taken directly off scales after setting magiceye to maximum. Completely self-contained power supply. Attractively finished steel case with rounded corners and etched panel. Operates from 220V AC.

Price: $40 (£20) Plus 12½ p.c. Sales Tax.



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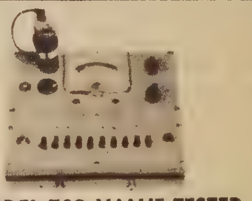
Input Impedance—50,000 Ohms.
Output Impedance—15 Ohms.
Ideal for reproduction of records for P.A. work, either music or speech in small halls, factories, shops, garages, etc. Base is steel finished in grey hammertone with blue and white front panel and white knobs.

PRICE IS ONLY **$25.95 (£12/19/6)**



TECH MODEL TC2 VALVE TESTER

Operates from 240 A.C. supply.

Will test all modern type tubes with miniature 7-pin miniature 9-pin octal and Locter Sockets. This Tester will check filament continuity, shor circuits in any elements and also omission. Overall size is 10in long, 8¼in wide, 3in deep. Meter size 3in x 3⅞in. Instruction and valve data sheets are in metal drawers at bottom of tester. A really compact job, ideal for portable use or on the bench. Weight 5¼lb

Price is only $30 (£15)

TOTAL: $33.75 (£16/17/6) plus postage.

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ranges, with respect to each other, our checks reveal that they vary by no more than 2 per cent, which is very good indeed. On the ohms ranges, the absolute accuracy was not so good, with a deviation as much as 4 per cent. It should be noted, however, that this is still within the resistor tolerances.

So there it is, the decision on this score is up to the builder, as to whether accuracy or economy is the more important. The rest of the resistors in the unit are all 1 watt rating, with the exception of the two 4.7M grid resistors where half watt types are desirable because of space limitation.

Coming now to the 6CG7, which is arranged in the usual bridge configuration, the second triode grid is held substantially at earth potential, while the signal is referred to the first triode grid. The meter movement is across the two cathodes, and the meter registers the unbalance which is brought about by injecting a signal into the first triode grid. In order to accommodate positive and negative voltage readings, the meter connections are switched and reversed as required. AC and DC calibration and Ohms zero adjustment potentiometers are also included in this part of the circuit.

The meter zero setting is effected by a potentiometer in the plate circuits of the 6CG7. This potentiometer is adjusted to cancel any unbalance in the particular valve, together with the rest of the bridge circuitry. A positive HT voltage is fed to the rotor of the balancing potentiometer, while an equal negative HT voltage is fed to the junction of the two 47K cathode resistors. As the grids are referred to earth, and due to cathode follower action, the two cathodes are at approximately earth potential.

The 10K zero setting potentiometer should be of good quality and capable of carrying the current of the valve. A wire-wound type is suitable and at the time of writing, we understand that a moulded carbon, type E made by Plessey should be available and would be suitable. The ordinary carbon-track type is not particularly recommended as it may give trouble with the current involved. The ohms-adjusting potentiometer should also be of good quality but we can see no reason why the usual type would not be satisfactory. The AC and DC calibrating pre-set type potentiometers may be eliminated and replaced with the correct value of fixed resistance.

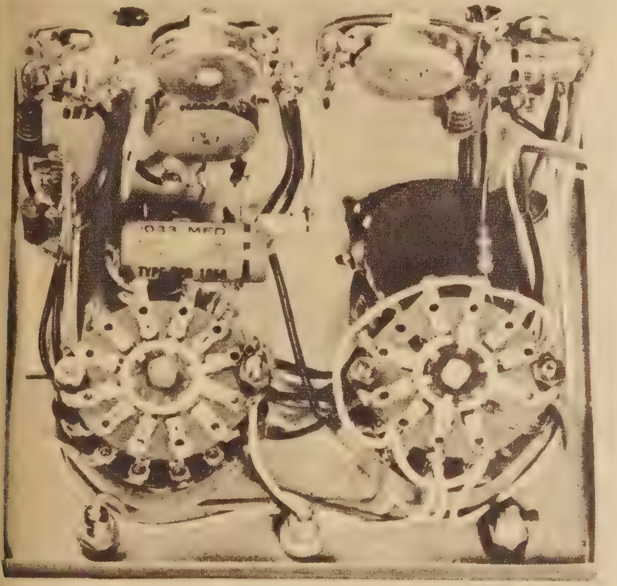
Considering all the switching as a whole, it is difficult to imagine how it could be further simplied. In order to avoid the use of another wafer, we elected to bring the Ohms range out to a separate socket on the panel. Opinions may differ as to which way this should be done. The issues are clear cut however. The method which we have adopted is the simplest and most economical while the use of another switch section would make operation of the instrument a little more convenient.

The power supply is about as simple as it could be. A voltage doubler delivers a total high tension of about 264 volts, with the junction of the two electrolytic capacitors connected to earth. This avoids any extra components to perform this splitting function. As only about six milliamps of HT current are required, the value of the electrolytics does not have to be large. The value of 8uF which we have selected is a good compromise between small size and ripple on the HT.

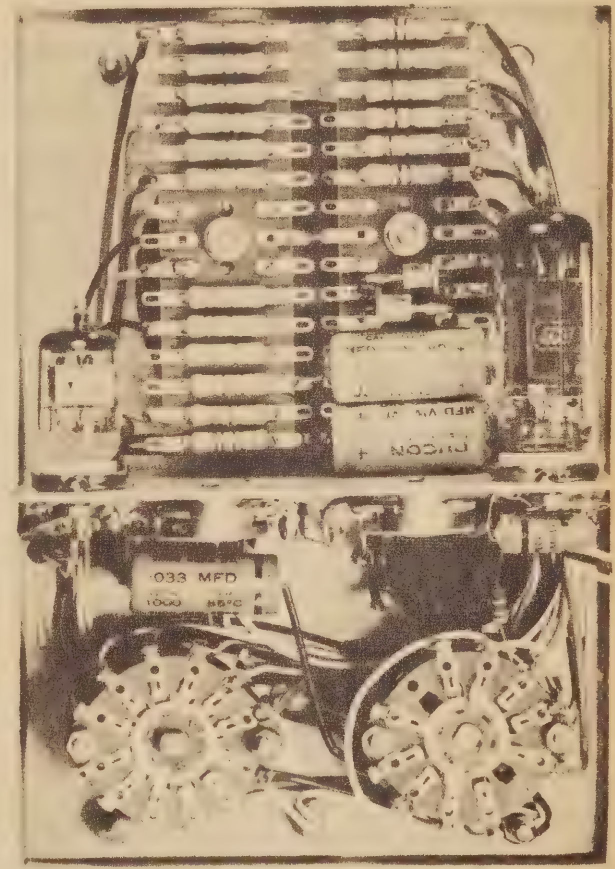
The power transformer which we have used is rated at 75V-0-75V, or 150V-125V-100V-75V-50V-25V, at 30 milliamps and the heater winding is 6.3V at 1.2 amps. The 125V tap is used for our purpose to give the required DC voltage. This tap also allows 400 PIV silicon diode rectifiers to be used, whereas the 150V tap would be operating these diodes over the 400PIV rating. The dimensions of the transformer are: 2 inches high, 1-7/8 inches wide (over coils) with 2¾ inches between mounting centres. The 3-volt supply for the Ohms range is obtained from two type 950 dry cells (or the leakproof equivalent) in series.

Turning now to the mechanical aspect, the unit is housed in our small instrument case, measuring 7½ inches high, 5 inches wide and 4 inches deep. The front panel layout is compact but all controls are conveniently arranged and easy to use. At first sight, it may appear that the vertical arrangement would lead to mechanical instability. By careful placement of components, it has been possible to keep the centre of gravity where it belongs and so it is not likely that there will be any undue tendency to tip over.

As the amount of space inside the case is rather limited, it was found necessary to give quite a considerable



The AC Cal. preset pot is located on the right of the sub-panel, with the DC Cal. on the left and the AC Zero preset pot immediately below. Range switch wafers have 12 positions, with only six used.



The two valves are mounted in the extreme corners of the sub-panel to avoid heating the resistors. The tagboard drawing should be checked against this photograph. Note the clear space around each of the mounting nuts.

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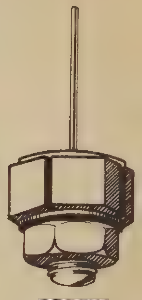

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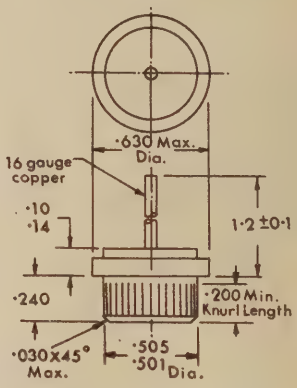

OUTLINE DIMENSIONS IN INCHES

MAXIMUM RATINGS	IN3659 IN3659R	IN3660 IN3660R	IN3661 IN3661R	IN3491 IN3491R	IN3492 IN3492R	IN3493 IN3493R	UNIT
Peak inverse voltage	50	100	200	50	100	200	Volts
Sine wave R.M.S. supply voltage (Resistive load only)	35	70	140	35	70	140	Volts
Sine wave R.M.S. supply voltage (Capacitive or battery load.)	17	35	70	17.5	35	70	Volts
Average half wave rectified forward current. @ 100°C case	30	30	30	25	25	25	Amps
@ 150°C case	25	25	25	18	18	18	
Recurrent peak forward current (50 cps and 25°C case)	100	100	100	75	75	75	Amps
Peak one cycle surge current (50 cps and 150°C case temp.)	400	400	400	300	300	300	Amps
Forword voltage drop @ 25 Amp. D.C., Forword current	1.2	1.2	1.2	1.2	1.2	1.2	Volts
Average full cycle reverse current at rated P.I.V. and I.F. (Resistive load, 150°C case.)	5.0	4.5	4.0	10	10	8	mA
Thermal resistance junction to case	1.0° C/WATT TYPICAL						
Operating junction temperature.	+175° C						

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amount of thought to the layout of the components, keeping in mind the need for convenience of wiring, avoidance of heat problems, etc. With this thought in mind, we suggest that the original layout should be adhered to strictly.

Fixed behind the meter to its terminals, are two miniature tag strips. These strips accommodate all the multiplier, Ohms reference and the two 47K cathode resistors. In addition, the two silicon power diodes and the electrolytics are mounted on one of the strips. The tags on each strip, on either side of the centre holes which are used to mount the strips to the meter terminals, are not used and the resistors which are mounted on the adjacent tags are placed underneath. This gives easy access to the meter terminal nuts.

Consideration was given to the idea of using a printed board to mount the items just referred to. However, it was reasoned that the tag strips would be more readily obtainable and perhaps what is more important a reduction of about $2 in cost would be achieved. A printed board would be a little easier to wire up but the difference would not be very great in this instance.

A sub-chassis, in the form of an "L", is placed immediately below the meter and fixing to the front panel is effected under the bushes of the Zero and Ohms potentiometers. The valves are mounted in the corners, so that they will be as far as possible from the resistors on the tag strips, to avoid heating these components. A couple of large holes are drilled alongside each valve socket to assist in ventilation. The three pre-set potentiometers and a 5-tag strip for one of the 22M resistors are also fixed to the sub-chassis.

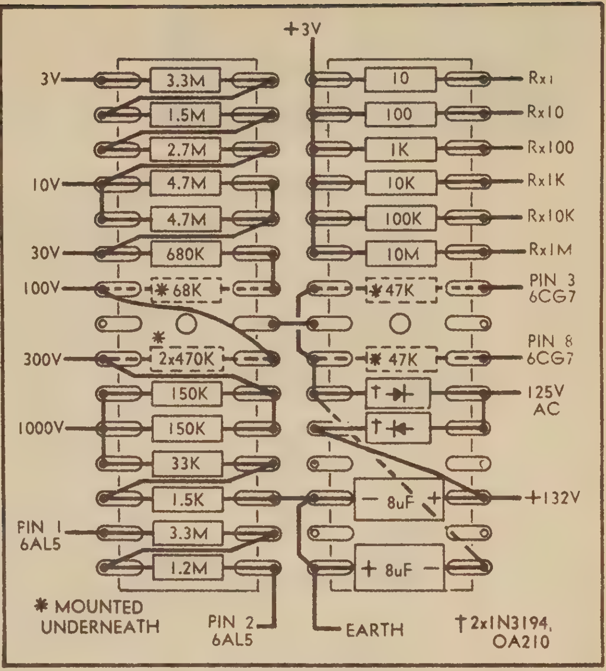
The range and function switches are mounted on the front panel, immediately below the Ohms and Zero potentiometers, respectively, the three input terminals being placed below the switches.

The power transformer and two dry cells are placed in the case at the bottom rear, where they occupy the space behind the switches. The transformer is mounted on the side of the case and the cells are held with a clamp made from a 3 inch by 1 inch strip of aluminium. The clamp is held with a 1½ inch by 1/8 inch Whitworth screw on the back of the case and passing between the cells.

In the space between the cells and the switches, a 10-tag strip is mounted to terminate the transformer leads. The strip should be carefully placed so that it will not be too near other items, as the mains and other high voltages are involved. The power cord is brought through a rubber grommet on the back of the case and a clamp holds the cord to the bottom of the case.

While we are on matters concerning the case, it will be noticed from the photograph, that there are two rows of ventilation holes, one on the bottom and the other on the back, near the top. Also, four rubber feet are screwed to the bottom of the case, with another four on the back, so that the instrument may be used in the normal upright position, or it may be laid face-up, if more convenient.

To get on with the construction of the VTVM, we will assume that you have all the metal work, ready drilled. Fix the two valve sockets, three pre-set potentiometers, two rubber grommets and one five-tag strip to the sub-chassis. Then fix the chassis to the front panel with the Zero and Ohms potentiometers. The three banana sockets are next, followed by the two switches. Now screw the meter to the panel and the job of assembly is more than half done.



We suggest that this layout be used, the arrangement having worked out very conveniently. Note the strap across adjacent tags in the centre with another strap joining earth points, three from the bottom.

Leave this part of the unit for the present and concentrate on the items to be mounted in the case. Fix a grommet into the hole at the back, pass the power cord through and clamp it down. Screw the transformer to the side of the box, fix the 10-tag strip in and terminate all the transformer and power cord leads to it. Reverse the ends of the two cells and solder a lead between the positive and negative of one end of the pair. With the lead facing downwards, clamp the cells into place, with about ⅛-inch clearance from the bottom of the case.

Take two miniature tag strips, each having 15 pairs of tags. These strips have to be mounted finally on the meter terminals, through the centre hole (eighth from either end) of each strip. The holes will need to be enlarged to clear the bolt of the terminal. This done, mount a strip on each terminal temporarily. The spacing should be such that there is a clearance of about 1/16-inch between the inner tags of the two strips. This spacing may be adjusted by filling the mounting holes and moving the strips with respect to each other.

Before removing the strips from the meter, drop a short piece of tinned copper wire through the inner centre tags of the two strips and solder them together. Do the same with the two tags which are the third in from the end nearest the sub-chassis. This serves to bring the two strips together into one unit, with no chance of any short circuits occurring between other inner tags later on. Remove the strips from the meter.

The job of wiring is best started with the tag strips. The details of this wiring are shown in figure 1. It is important to note that the resistors on the tags each side of the mounting points, are placed underneath. One other point worth noting, particularly if the cheaper resistors are used, is that a minimum

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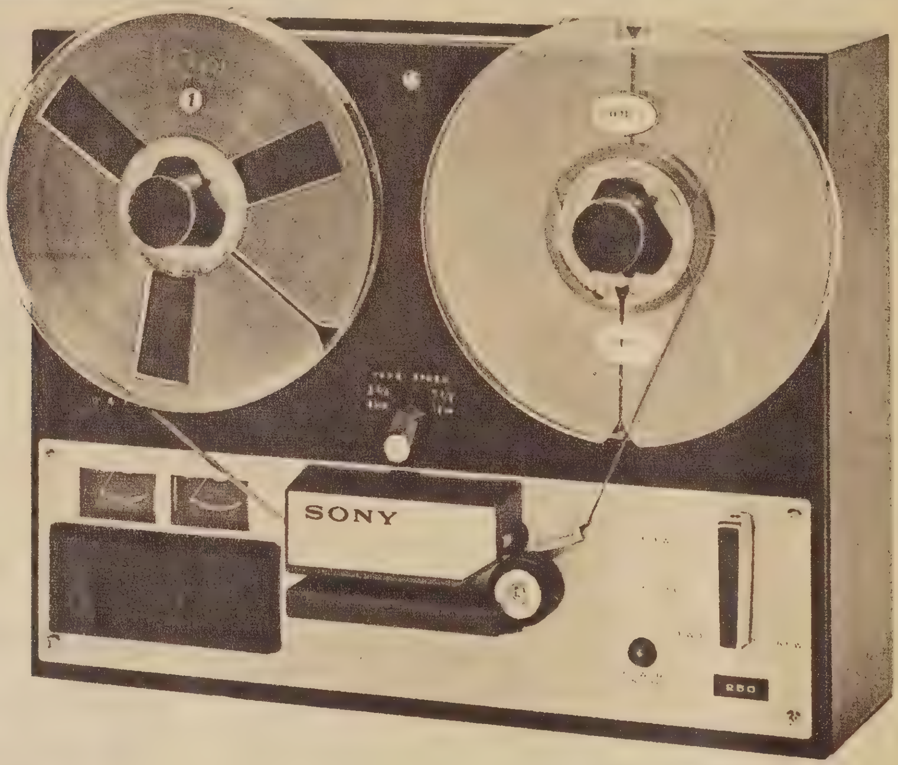

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Output:	Low impedance line outputs Auxiliary Record/Playback connector
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of heat should be used when soldering, as excessive heat may cause a shift in resistance value.

The way we mounted the tag strip to the meter calls for two extra nuts for the meter terminals. This is necessary to stand the tag strips off the meter body sufficiently to give clearance for the underneath resistors. If nuts are difficult to obtain, then the clearance may be achieved with washers instead of the extra nut thickness. We also put the solder lugs for the meter between the first and second nuts, which brings the lugs under the tag strips. Alternately, the lugs may be fixed under the top nuts, above the strips.

With all the components assembled, a relatively small amount of wiring completes the job. There are, however, a few points which must be watched in the wiring, as a misplaced component may cause fouling when an attempt is made to fit the front of the unit into the case. Keep all components under the sub-chassis close in. Watch placement of the input coupling capacitor and the 4.7M resistor from pin 7 of the 6CG7 valve to the switch. Swing the middle 22M resistor across the outer tags of the 5-tag strip. From each end of this resistor, run a 22M to the 6AL5 valve and one to the "AC Zero" potentiometer.

Four leads have to be run between the front section and the components in the case. These are: two heaters, one earthed, 125V AC, and plus 3V for ohms measurements. The two heater leads may be run from the socket of the 6CG7, to the tag strip in the case. The other two leads can be twisted together with the heater leads, between the valve socket and tag strip. This section should be about 9-inches long, which allows the front section to be removed to make adjustments under operating conditions.

The wiring finished, a careful check should be made to be sure that there are no errors. After applying power, it would be a good idea to check the positive and negative high tension to see that it is approximately plus and minus 132 volts, as shown on the circuit. All being well adjustment and calibration completes the job and the VTVM is ready for adjustment and use.

A little care and patience in adjusting and calibrating the instrument is very worthwhile, as a careless job at this stage can spoil an otherwise excellent instrument. The recommended procedure is as follows:

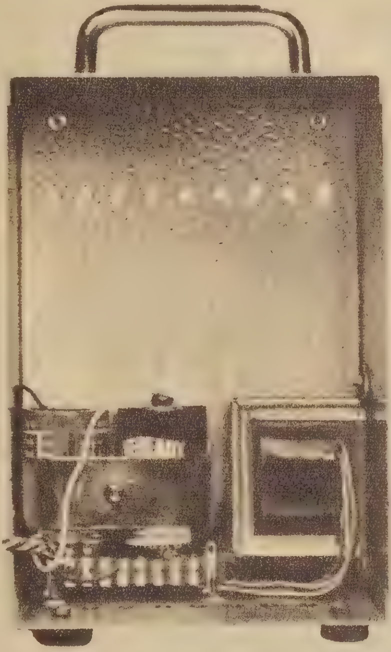
Before switching on, set the meter needle precisely to zero. This is very important, as the constancy of the zero reading for the various ranges depends on this initial adjustment. Set the "AC Calibrate," "DC Calibrate," "Zero" and "AC Zero" potentiometers to approximately their mid-position. Switch on the power and leave the instrument for about 15 minutes to warm up.

Set the range switch to 1000V and the function switch to "+DC." Adjust the "Zero" knob on the front panel so that the meter reads zero. Switch from "+DC" to "-DC" and the meter needle should not move. The correct setting of the Zero knob is such that, when switching from +DC to -DC, there should be no shift of the meter needle.

Turn the range switch to 3V. Changing the function switch now from +DC to -DC will possibly give a needle shift of about 25 millivolts, equally about the true zero position.

Turn the function switch to "AC" with the range switch still on 3V. Adjust the "AC Zero" potentiometer until the meter needle reads precisely zero. This position should now be maintained over all the AC ranges from 3V to 1000V. Before proceeding any further, it would be a good idea to recheck all the adjustments which have been made so far.

Perhaps the job of calibration may present a problem to some readers. If the best possible accuracy is to be obtained from the instrument, it must be calibrated against a meter of known accuracy. There is no easy way out of this, but most readers will no doubt be able to borrow a suitable meter, if one is not already on hand.


Transformer, dry cells and tag strip have been carefully placed to avoid fouling items on the front panel. Mains input occupies first three tags on the right. Note ventilation holes at bottom and near top.

Fortunately, it is only really necessary to calibrate one range for DC and one range for AC. The accuracy of the other ranges will depend upon the accuracy of the resistors in the voltage divider network.

Any range may be calibrated, but perhaps the 10V range for both AC and DC would be the most convenient. Twelve volts DC may be obtained from a car battery, for instance, and about 12 volts AC may be made up by connecting two 6.3V heater windings (correctly phased) in series.

To calibrate the 10V DC range, connect a potentiometer of about 1,000 ohms across the battery or other source. The VTVM and the calibrating meter are connected between the negative and rotor terminals of the potentiometer, which is adjusted to 10V against the calibrating meter. Adjust the "DC Calibrate" potentiometer, so that the VTVM reads precisely 10V. The AC range is calibrated in a similar manner.

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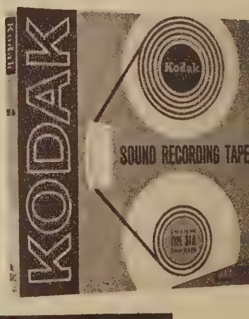

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the "Answer Man" Explains

BALANCED AND UNBALANCED AUDIO LINES

A reader from Victoria, with a growing interest in audio amplifier systems, asked us recently to explain the difference between balanced and unbalanced audio lines. The answer was too involved for our query service, but it makes ideal material for "Answer Man."

What is the difference between balanced and unbalanced lines in relation to microphones and tape recorders?

Most of the audio equipment with which enthusiasts and hobbyists have to do uses what we can loosely refer to as the "unbalanced line" system.

In keeping with this, the input connectors to the majority of "domestic" amplifiers and tape recorders involve a single "active" element or terminal, with which is associated an outer shell or an "earthy" terminal. Thus, the input circuit is completed by means of one "hot" or "active" connection and one "earthy" connection.

When feeding a pickup into such an amplifier or tape recorder, it is normal to identify the active signal lead and ensure that it connects to the active input terminal or the active element of the input plug/socket combination. The outer shield braiding connects to the earthy terminal or to the earthy element of the input plug/socket system. If the pickup has a separate "earth" lead inside the shield cable, this also connects to the earthy side of the input system.

Exactly the same observation applies to microphones, to connections to radio tuners or connections between, say, a tape recorder and a separate power amplifier. They are normally effected by means of a shielded cable, with an active inner conductor and the earthed braid, the other inner conductor (if present) being also earthed.

In the case of a stereo system, the observation applies to the two channels. Each signal normally involves its own active lead, one for right channel and one for left, the earth circuits being separate in some cases, and common to both channels in others.

By and large, this "unbalanced" system is adequate for ordinary domestic or non-critical commercial use and has the advantage of relative simplicity.

However, in recording and broadcast studios and a variety of situations, microphones, pickups, control consoles, tape recorders, etc., are likely to be separated by quite substantial distances, involving long connecting cables. This introduces problems not found in domestic installations.

Despite all care with the positioning and shielding of such cables, they are likely to pick up hum and other interference, due to stray magnetic fields from power wiring, and to actual 50-cycle voltage drop along nominally earthed power circuits.

To minimise troubles of this kind, it is standard practice, in professional audio circles, to make the signal circuits substantially independent of earthed wiring and shielding. Instead of the signal being carried by one wire and an earthed shield braid, the signal is carried by two wires, neither of which is earthed. The outer braid serves as a shield only, effective for both inner conductors.

The system demands that both ends of the coil in a pickup be brought out by leads separate from the shield braid; similarly for microphones. This, in fact, is often done with pickups and microphones intended for home use though, as already mentioned, the home user normally earths one of the wires directly to the braid and to the equipment chassis.

Similarly, other signal sources, such as radio tuners and tape equipments, must be designed to deliver signal between two active output leads. This involves some special circuit provision, usually in the shape of an output transformer with secondary winding independent of the rest of the circuitry.

Amplifiers, preamplifiers, tape recorders, etc., intended for use with a balanced system must accept both input leads, isolated from earth, as well as the earthed shield braid. What is more, the equipment must utilise both input leads and this involves either a balanced "push-pull" type of input circuit or a built-in signal transformer having, usually, a centre-tapped input or primary winding, with the tapping earthed and the two ends free to accept a signal.

As might be expected, the provision of twin shielded wiring instead of single-shielded wiring, along with appropriate plugs and sockets and equipment input and output circuitry to suit, adds up to extra cost and complication.

However, the technique has the vital advantage that hum and interference which may penetrate the line, tend to induce a similar effect in each conductor, since they are balanced in respect to their environment. The spurious signal, appearing in phase in both lines, tends to cancel when it encounters the balanced or push-pull type input circuit. This is one of the vital reasons, in fact, why signals in a studio can follow such a lengthy and devious path and still emerge virtually free from hum and other extraneous interference.

Perhaps it should be mentioned also that the need for long cables in professional audio installations makes it necessary to consider the impedance level of the associated circuits. If the impedance level is very low, DC resistance in lines and possibly switches may introduce loss due to IR drop. If impedance is very high, capacitive shunting will produce loss of high frequency response.

To minimise both effects, it is usual, in professional audio circles, to transfer and control all signals at a nominal impedance level of about 600 ohms. Thus, pickups and microphones are equipped with coils—or output transformers — having about this nominal impedance, while the same figure is used for the input and output circuits of preamplifiers, line amplifiers, tape recorders and so on.

Thus, professional audio techniques centre round the 600-ohm balanced line concept and commercial equipment is mostly designed with this fact in view.

By contrast, equipment for purely domestic use tends to assume the unbalanced (and less expensive) approach.

In between, in equipment which could conceivably be applied in either field, it is not uncommon to find some provision for both techniques as, for example, alternative high and low imped-

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Finally, while we have related the use of balanced, medium-impedance systems to broadcast and recording studios, which provide the classic example of their use, it should also be mentioned that the techniques find application in fairly modest sound reinforcement systems, where microphone lines may still be long enough to produce trouble, unless they are of the balanced medium-impedance variety.

★ ★ ★

What is the meaning of the term "crossover distortion" which I see mentioned so often in relation to audio amplifiers?

The term normally has to do with audio amplifiers having a push-pull output stage—but let's start at the beginning.

Ahead of such a stage, the signal to be amplified is normally passed through a phase-splitting stage or transformer, so that the two output valve grids can be driven in opposite phase. Thus, at any one instant, if one output valve grid is being driven by the signal in a positive direction, the other output valve grid is similarly being driven negative, with a phase difference of 180 degrees between the two signals.

The effects of the two plate currents, one increasing (with positive-going grid signal) and one decreasing (with negative-going grid signal) are appropriately combined in the output transformer, to drive the loudspeaker.

In the case of transistor audio amplifiers, the out-of-phase input signals are normally fed to the "base" electrodes rather than to the grids, the collector current in each transistor responding accordingly.

In a class-A output stage, the valves (or transistors) are biased at about the centre of their dynamic characteristic and are not driven, during any part of the signal input cycle, beyond the limits of their linear grid-plate (or base-collector) transfer characteristic. Each therefore operates over the entire signal input cycle and each assists the other in delivering power to the load.

In other modes of push-pull operation, the output valves or transistors are biased closer to their plate (or collector) current cut-off point. When signal is applied, the successive half-cycles of input signal increase the plate (or collector) current of one particular valve (or transistor) but drive the other one beyond plate (or collector) current cut-off.

Therefore, in the common output circuit, the two valves (or transistors) do not assist one another smoothly over the whole signal cycle. There is a tendency for one to handle "the lion's share" of one half of the audio input cycle and the other to handle the other half.

When the output valves or transistors are biased very close to cut-off, as in a class-B stage, the distinction is quite marked, each valve or transistor in the push-pull pair delivering power to the output load during ONLY one half of the signal cycle.

This leads, naturally enough, to speculation as to what happens, in such an amplifier, when the input signal is passing from the "positive" to the "negative" half-cycle and vice versa — when it is crossing the AC zero line, in other words.

Does one valve or transistor really cease to deliver power to the load at the precise instant that the other begins to do so?

Might there not be a break such that, over some section of the cycle, neither valve (or transistor) is operating?

Alternatively, might there not be an overlap period, where both are operating and, if so, would this overlap lead to non-linear power transfer?

As you might have guessed by now, the term "cross-over" in this context refers to this critical region, which occurs twice in each cycle, where one output valve or transistor is taking over from the other.

Another term which is used frequently to mean the same thing is "switching."

"Cross-over" or "switching" distortion refers to any distortion which might arise from non-linearity produced by this effect.

In practice, designers usually try hard to avoid the situation where the output valves or transistors are biased beyond plate (or collector) current cut-off, because this can produce a very serious discontinuity in the output current waveform.

On the other hand, they usually try to avoid biasing the output valves or transistors at a standing current too far above cut-off, because this is wasteful of supply power and increases heat dissipation problems, both of which are particularly significant in transistor equipment.

Designers, therefore, try to ensure that the output devices in a class-B stage are biased just above cut-off and that the small overlap region in the signal cycle, where both are operating, merges smoothly into the region where either one or the other takes over.

In this way, cross-over distortion is minimised, being usually further assisted by the operation of negative feedback around the output stage.

Curiously, cross-over distortion is most troublesome in class-B and similar amplifiers when they are handling relatively low levels of signal. Under these conditions, a large proportion of the total signal excursion is around the cross-over or switching region.

When the amplifier is handling large signals, swinging the plate or collector currents well up on their dynamic curves, the cross-over region represents only a small proportion of the characteristic in use and any distortion content is a small proportion of the total audio power being handled.

Another observation is that, while the remarks have centred on push-pull amplifiers of more or less traditional configuration, the terms can apply equally to any other configuration where the job of delivering power to the load transfers from one valve or transistor to another during discrete portions of the signal cycle.

★ ★ ★

What is the meaning of a recording process called "synchro-stereo"? The literature (Concert Hall) suggests that it is a recent development from Switzerland and is equally suitable for mono and stereo record-players. A note warns that the playing weight should not exceed 8 grams.

It is quite a while since we have seen a Concert Hall disc and we are therefore not able to speak from any direct knowledge of the technique.

We suspect, however, that it is a technique to which we saw some reference several years back, when the problem of mono/stereo compatability was more urgent than it seems to be now.

Our memory is rather vague but the basic idea seemed to be to deliberately limit the excursions of the cutting stylus which would demand high vertical compliance of the pickup. By doing this, the idea was to produce a disc which could be played with a mono pickup, without the latter inflicting undue damage to the groove.

At the same time, enough of the stereo effect was retained, by virtue of the limited vertical component, to give a reasonable stereo effect.

We have not heard anything of the technique since, and assumed that it had been dropped.

In Australia, the tendency over recent years has been to produce domestic record-players almost exclusively for stereo and even to equip mono players with stereo cartridges. The tendency is therefore for stereo to dominate the album market, and mono the 7-inch single-play and EP market. There would not appear to be much incentive to market a half-and-half kind of disc. Whether the one you ask about would be justly described as such we are not certain. ■

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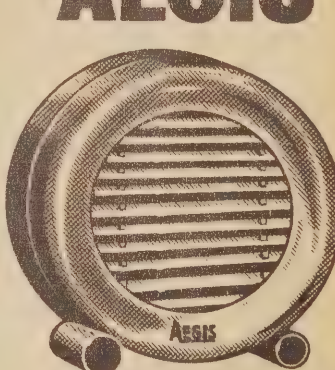

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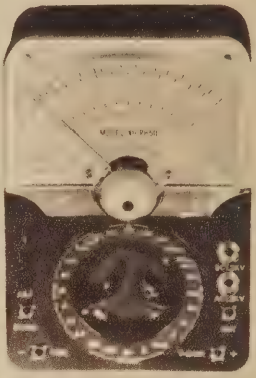

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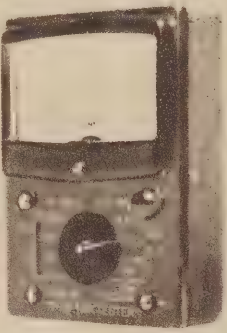

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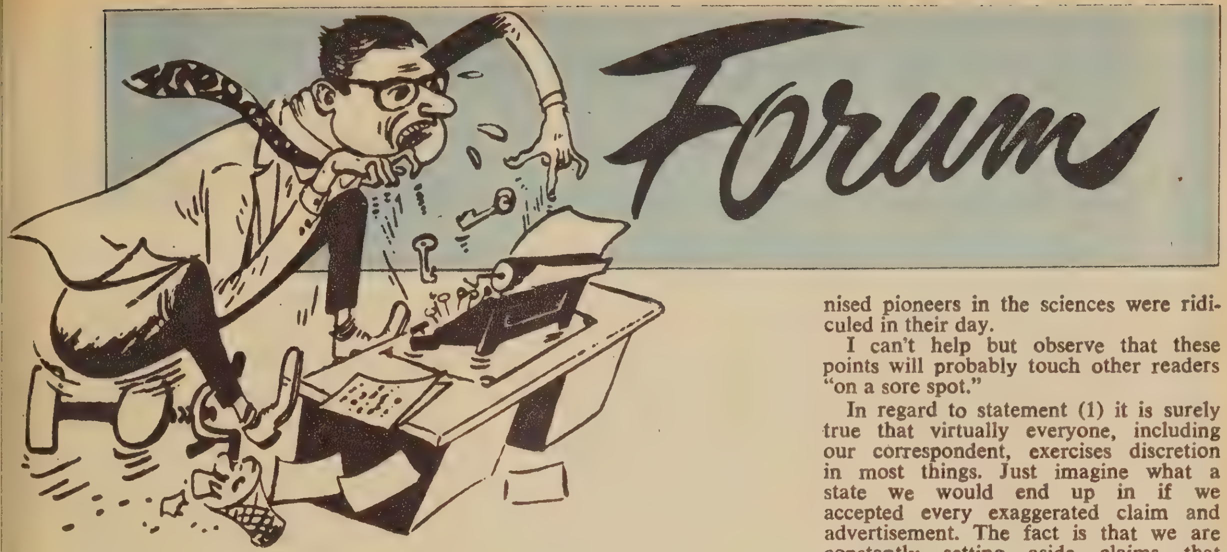

Forum

More about "Get-Well" gadgets

Our article in these columns, in the November issue, under the heading "Get Well—Electrically" brought forth the anticipated responses—from readers who obviously agreed with our general attitude and from others who were inclined to say (in the vernacular, "lay off and give 'em a go." We have selected two such letters to represent the particular points of view.

By W. N. Williams

THE first one comes from I. R. of Heidelberg, Victoria, who begins with "May I guess that this gadget originates in the United States?"

He then goes on to say that an investigation in 1963, by the United States Senate, revealed that approximately 250 million dollars are wasted annually on frauds in that country; that arthritis sufferers in particular, are being exploited with a variety of electronic and other gadgets at prices from 35 to 1,250 dollars apiece, all of them completely useless.

Among the gadgets the committee found an array of "hardware," in the form of metal rods, beads, rings and balls which are to be attached to various parts of the body, some with extensions which "need" to be dipped periodically into water and so on, ad nauseam.

The correspondent concludes with a cutting remark as follows:

"But is there a difference, except in degree, between advertising these health gadgets and, say, advertising 'more picture' in Australian television receivers?"

By way of comment, I cannot say whether or not the gadget, which we mentioned, had its inspiration in America but the description and the enthusiasm for its alleged virtues certainly came from a local correspondent.

As for the reference to "more picture n Australian television receivers," this s a subject that can now be reasonably nterred.

I gather that it started with the authentic concept of a 25-inch picture tube masked to provide the correct aspect ratio and electronic circuitry to minimise overscan effect. It finished up as a publicity slogan that implied something more han this and which affronted a large number of technically minded people.

Maybe that's why you haven't seen it for quite a while!

The second correspondent (J. A. of Woomera, S.A.) thinks that I should not have so summarily dismissed the gadget referred to in the November issue. He opens his letter with the suggestion that we have "touched him on a sore spot" and says:

"How about building one of these dinguses yourself. Pass it on to some completely unbiased person and maybe you will change your mind. The incidence of PSI sensitivities is low but, according to Dr Rhine of Duke University, at least three out of 20 have a certain amount of E.S.P. so, if your correspondent is correct in his claims, you should find one out of 10 subjects will experience some sensation."

Elsewhere in his letter, our correspondent refers to gadgets which seem to have no scientific basis but which, in his experience, have produced results of one kind of another. He comments further:

"As for 'pseudo-electronic quackery,' Doctor Semmelveiss was accused of being a quack for having the effrontery to claim that washing his hands before delivering babies reduced the incidence of puerperal fever among his maternity cases."

While, perhaps not too apparent from my precis and quotes, the letter can be stripped down to the following basic statements:

(1) I should not have condemned the gadget without actually testing it.

(2) Many such gadgets appear to produce effects, irrespective of whether the circuit makes sense to an electronic engineer.

(3) The effects would be most apparent to people who are good E.S.P. subjects or who can produce results with divining rods.

(4) It is significant that certain recognised pioneers in the sciences were ridiculed in their day.

I can't help but observe that these points will probably touch other readers "on a sore spot."

In regard to statement (1) it is surely true that virtually everyone, including our correspondent, exercises discretion in most things. Just imagine what a state we would end up in if we accepted every exaggerated claim and advertisement. The fact is that we are constantly setting aside claims that would seek to influence what we eat, what we wear, what we drive, where we live, how we wash ourselves, how we clean our teeth and so on ad infinitum.

I wonder how many times J.A. has decided not to build a certain piece of electronic equipment because he judged it to have less merit than some other design? Or to be not worthwhile?

Well on the basis of the knowledge that I have, I decided not to bother further with the gadget or the claims referred to in the November article. I could see no justification for any other attitude.

Referring to statement (2) the fact that certain people may profess to observe certain effects from a piece of electronic equipment proves nothing. Indeed, it would be most surprising, on a statistical basis, if the answers were 100 per cent negative. Such is the power of auto-suggestion that research workers have to take elaborate precautions to minimise psychological and other factors before they can extract worthwhile data on the basic worth of any treatment. If you tried hard enough, you could probably get somebody to testify quite genuinely to the stimulating qualities of a torch battery, carried in the shirt pocket just near the heart; but, provided you didn't tell them, the same person would probably respond just as well to a cell case packed tight with sausage meat.

Statement number (3) I find particularly obnoxious. E.S.P. is a very intriguing subject which is debated and studied in the highest academic circles. There are those who quite seriously extend their speculation into the realm of metaphysics. I, personally, have a quite open mind on the matter. But I think that it is humbug of the worst kind to put forward E.S.P. as explanation and justification of things more logically related to auto-suggestion, delusion, deceit and quackery of one kind and another.

As for (4) it finds a close parallel in the old statement that "all dogs are animals but all animals are not dogs." Of course, certain genuine pioneers were ridiculed in their day but that doesn't mean that all who suffer ridicule are genuine pioneers. If the intention is to establish some link between genius and ridicule, what about all the other great figures who were acclaimed in their

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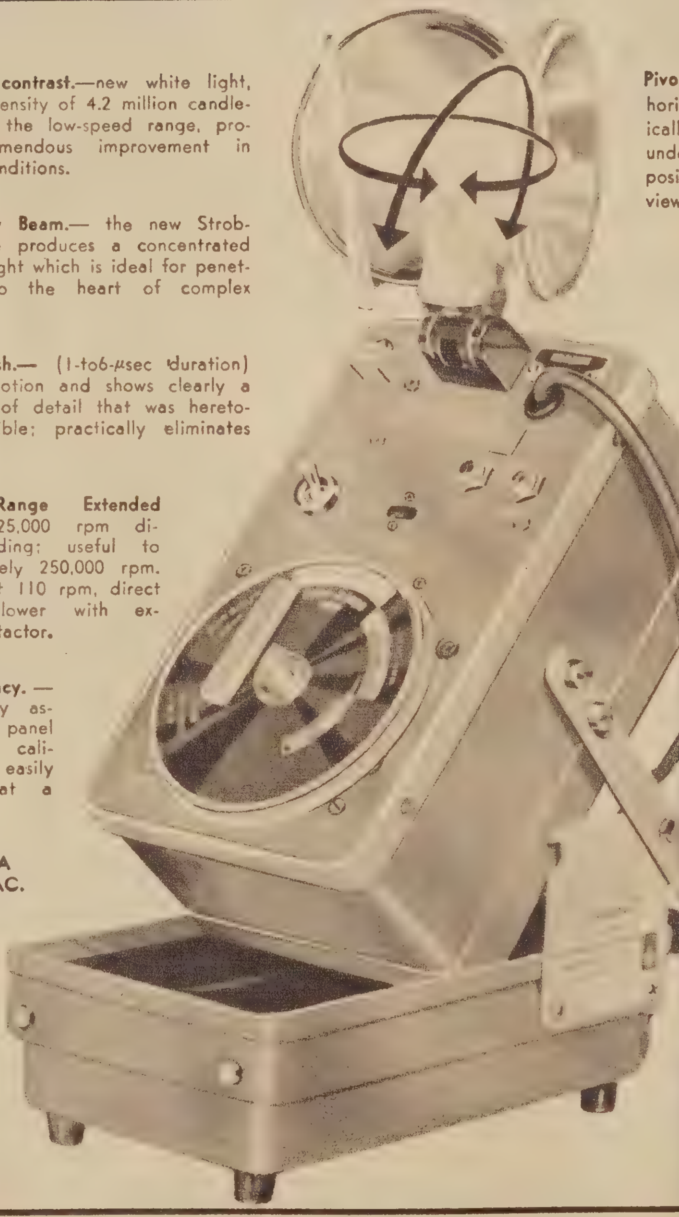

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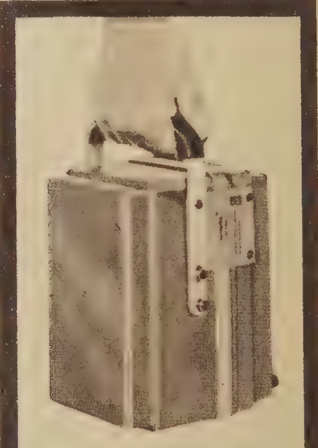

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Instrument Service Co., 993 Hay Street, 21-9767.

day? Must we assume that they were charlatans? In short, statement (4) means so little that it is hardly worth putting to paper.

But I guess that's enough for the time being of the "Get well electrically" theme. There'll doubtless be more to follow.

Also in the November issue was a further reference to "Alvin Generators," being a carry-over from an item in the August issue. To jog your memory, it had to do with methods of doubling the frequency of sounds to produce a result akin to the "Chipmunks" recordings.

It started quite an argument in our own laboratory but it also triggered a couple of readers into doing some mathematical analysis of the procedure.

I.P. of Roseville, N.S.W. appears to agree with what we said and no further comment is necessary.

However, P.H. of Camberwell, Victoria starts off in a quite different tone. I quote:

"Your conjecture that the Hall effect device can be used as a frequency doubler in the way you suggest for a complex signal is incorrect."

Then follow a couple of pages of mathematically-based argument, all aimed at proving that frequency doubling of complex tones would be accompanied by intermodulation products, which would presumably render the final signal quite unacceptable.

In performing this exercise, P.H. commends himself as a thinker and a writer but, unfortunately, leaves doubts about his performance as a reader.

Stimulated by our reference to the Hall effect device as a frequency multiplier, he hastened to put pen to paper to prove us wrong. The only trouble is that the very next paragraph in our article says:

"But—and what a but it is—while it would be a most effective doubler for single tones, it would also be a most effective intermodulator for multiple tones. And I doubt if there's any more unpleasant sound than thoroughly intermodulated audio."

Man alive, if P.H. can pick a 3-page argument over something which is in line with his own thinking, what sort of an effort would he make in the face of a positive disagreement?

FROM "THE BUSH"

The recent discussion, in these columns, about the A.B.C. dropping its twin-AM-station stereo broadcasts brought forth a quite unexpected retort from a reader in Gladstone, Queensland, who may be identified by the initials B.G.

Of necessity, I must condense his rather colorful off-the-cuff style but his sentiments run something like this:

"You people in Sydney have nothing to complain of. But absolutely nothing.

"I'd like you to come up to this part of the world—where specialists in the electronic tom-tom and screaming cats come from or are bred—and try to enjoy a good program.

"When I was young, I enjoyed listening to good dance bands like Ambrose, Jack Hilton, etc. But, alas, I have to agree with the program manager of the C.B.C. (Canada) that it is high time for radio stations to start educating people instead of giving them the lowest possible denominator, because that is drug and not entertainment.

"Now a few people in Sydney have lost their precious stereo. Bah.

"I own a late-model transistorised receiver, approaching communications standard, and a transistorised tape recorder. When a good program is on, I go right out into the bush, away from the electricity supply wires, tape the lot and try later to enjoy the canned result

"Normal listening is possible alone on the 60-metre A.B.C. station and since the policy of the program suppliers has altered, there is not much left."

Behind these remarks from B.G. is a double-barrelled complaint.

The first is that radio stations devote so much of their time to teenage sound, to advertisements and to chatter that they have alienated a very large section of their potential audience. In terms of profit and loss, the move may be justified but, as we have said on other occasions, it has provided a very substantial incentive for people to arrange their own music via record players.

And it is creating the right atmosphere for the introduction of tape cassette players in cars.

The second point has to do with the very severe limitations on the AM (amplitude modulated) medium-wave broadcasting system, on which Australia is currently dependent. The band is jammed full of signals but, in average areas, most of them are robbed of any real entertainment value by mutual interference, by fading, atmospherics and man-made noise.

If you have any doubts on this latter score, they can very effectively be dispatched by doing some listening on a portable or car radio, close to and remote from power wires. Maybe this is the price we have to pay for the convenience of near complete reticulation, but it hits hard at those who have to win their radio reception from a few microvolts of signal.

And, of course, it provides justification for the loud chorus of "I told you so's," from those who were opposed to deletion of the VHF FM band. They now claim that FM sound from a limited number of television transmitters is putting to shame the service from a very much larger number of medium-wave AM stations.

Unfortunately, our correspondent is not excited by the availability of television sound. He concedes that modern television is very efficient — at promulgating murder, lust and vice! But that is another story which relates not just to what is available but by what one chooses to view. ◘

Dear Sir,

Reading your article in December issue of Electronics Australia "A Radio Control System for Modellers," I was pleased to see your reminder to enthusiasts that P.M.G. Regulations had to be met and to note publication of the regulations on page 87.

There was however, an error in the address given to the South Australian office of the Radio Branch, possibly because your information came from an older brochure. Since it is possible some of your readers could be following up your article with further inquiries, the correct address is:

Superintendent,
Radio Branch,
C.I.C. Building,
31 Franklin Street,
Adelaide.

Your stressing of the frequencies allowed is to be commended, as too often enthusiasts purchase equipment, usually Japanese, which is outside the operating bands; this means that approval to operate cannot be given. Matters are made more difficult by the non-availability of the circuit diagram.

Wishing you every success in fostering the art.

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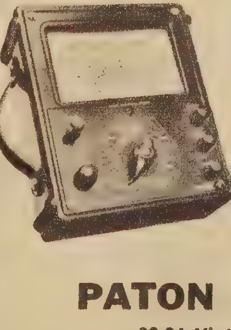

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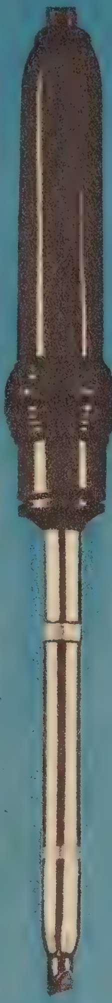

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The Serviceman

WHEN A SET IS TOUGH ON BATTERIES—

What looked like a routine battery replacement for a pocket radio turned out to be an unusual service job. So unusual, in fact, that I doubt whether anyone else is ever likely to strike it. Nevertheless, it is interesting as a lesson in never taking anything for granted—and this applies to the receiver manufacturers as well!

THE job started in the usual way, with the teenage owner asking for a replacement battery. However, he went on to comment that he wasn't very happy about the life he had been getting from batteries and suggested that there must either be something wrong with the quality of the batteries or a fault in the set itself.

The comment didn't surprise me. In fact, I find it is quite a common one, though usually quite groundless technically. Instead, it turns out to be simple lack of appreciation on the part of the owner on what is reasonable to expect from such equipment.

There are several reasons for this. One, I feel sure, is the emphasis which was placed on battery economy when transistors replaced valves, and which seems to have over-indoctrinated the public to the point where some of them seem to expect a battery to last forever.

Not that I blame those who emphasised battery economy. Considering the vast difference between the old and the new, it was a perfectly normal reaction. Unfortunately, there are a lot of other factors which the public do not always appreciate.

One is that modern sets; particularly the pocket variety, are only a tiny fraction of the size of the old valve sets and that the batteries have been similarly scaled down. Even allowing for the greater operating economy, the batteries are very much smaller—relatively—and so cannot be expected to give the same life.

On top of this is the fact that, as speakers become smaller, it takes more audio power to make the same noise, and this power must come from the battery.

Again, these sets invariably use a class B output stage. This is a very efficient arrangement in which the power consumed is very closely related to the volume delivered by the speaker at any instant. And, when operated at a sensible level, it gives quite economical battery life.

But whoever heard of a teenager who operated a pocket radio at a sensible level? Invariably, the volume control is set "flat out," to make as much noise as possible with complete disregard for the hideous distortion which results. (After all, what's the point in having the thing, if you can't make everyone within a radius of 50yds appreciate the fact?)

Under these conditions power consumption goes up at an alarming rate, as can be very quickly shown by connecting a meter in series with the battery and winding the gain up. I try to demonstrate this whenever possible; not only does it help me prove my point, but, who knows, it may even make a small contribution to noise abatement in our over-crowded transport system.

Finally, there is the natural enthusiasm which goes with any new toy, and which results in it being consistently "flogged" for the first couple of weeks, plus the inevitable "forgetting to switch it off" on odd occasions.

All of which adds up to pretty solid battery consumption, and is normally the main or only reason for the short battery life. I usually treat such complaints by measuring the receiver battery drain and, if it is normal, advising the customer of this and adding a few comments based on the above discussion. Once they know there is nothing wrong with the set and commence to practise a little discretion in its use, they seldom have any more trouble.

I imagined it would be the same in this case, and offered to test the current drain while the customer waited, to set his mind at rest. First, however, I took a careful look at the set as he had given it to me. The first thing I noted was that the set was switched on as he handed it to me, even though it was not functioning. The second was that the battery when tested, proved to be completely dead; not just weak, but virtually incapable of moving the meter needle. It looked as though the set had been left on long after it had ceased to function.

I selected a new battery and connected it into circuit with a clip lead and the multimeter leads. The set came to life immediately and a quick check showed that the standing current with no signal was around 6mA, peaking to 20mA plus with peaks as the volume was advanced. Allowing for the inertia of the meter, it was probably a good deal higher than this. However, such performance is about normal for this set and I advised the customer accordingly, at the same time taking the opportunity to demonstrate how louder signals drew more current.

Then, as a final check, I switched the set off. Immediately, the cause of the customer's complaint became obvious for the current drain remained at 6mA. Small wonder the set had been gobbling up batteries, with this order of drain 24 hours a day.

Although comparatively rare, this is not the first such case I have struck and I assumed that it was just another case of faulty pot switch contacts. At my suggestion, the owner left the set with me to repair or replace the pot, whichever seemed most desirable.

With the set on the bench I took a closer look at the pot switch. It was typical of the simple mechanical arrangements commonly used in such sets; a kind of cam-action device whereby the rotary action of the pot shaft lifts a small spring contact clear of a fixed contact. Since all this is clearly visible, it didn't take me long to establish that the two contacts were, in fact, being clearly separated every time and, as far as I could see, there was no other path by which current could flow.

Nevertheless, with the battery removed and an ohmmeter connected across the switch contacts, there was a clear indication of continuity, even when I inserted a piece of thin card between the contacts.

I took a closer look at the whole set-up. The combined pot switch was mounted at one corner of the printed wiring board, while the battery leads connected to the printed board on a remote side, with a pair of copper strips connecting the two together. As far as I could see there was nothing to provide the mysterious path across the contacts, yet the meter insisted that it was there.

Picking up a sharp pointed probe, I ran it along the board between the two copper runs from the battery to the switch. About half way along I felt a slight obstruction and took a closer look. There appeared to be a slight ridge under the varnish, but it was so slight that I would never have noticed it normally and I certainly could not see what was causing it.

I stroked it gently with the probe a couple of times then, with my eye on the meter, I pressed a little harder as the probe went across the ridge. And, Presto, the meter flicked back to zero as the probe pushed something out of the way.

What was it?

I'm afraid I'll never know for sure. All I know is that it appears to have been incredibly fine; so fine that I couldn't see it properly even when I knew it was there. I imagine that, having been pulled clear by the probe point, it dropped immediately, leaving me with virtually no chance of finding it.

The two most likely possibilities are (1) a sliver of solder caused by an operator's carelessly flicked iron or (2) a thin line of copper caused by faulty photography or etching when the board was made. All things considered, I think (1) is the most likely.

However, the really intriguing part of the story, I feel, is the fact that the fault must have been in existence from the time the set was made and, presumably, was overlooked by the various testers simply because it was not a fault which upset the actual performance as observed by the user. Even if a current consumption test were made, it would still not reveal it unless it specifically included a test of the "ON/OFF" function.

Which just goes to show that neither a manufacturer nor a serviceman can afford to take anything for granted.

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92 DXERS (Batt.) 2
93 DXERS A.C. 2
94 DXERS A.C. 3
95 DXERS 3 Band 3
96 Little General 1961
97 Interstate 5
98 1962 Stereogram
99 Fremodyne 4
100 Amateur RX
101 Transistor 1
102 Transistor 2
103 Transistor 3
104 Transistor 4
105 Transistor 5
106 Transistor (R.F.) 7
107 Transistor 8
108 Transistor 3 Band 8

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To change the subject rather abruptly, I encountered a fault recently which has prompted me to make some general remarks about a particular design feature of some sets.

Briefly, the fault was one which, initially, gave the appearance of an AGC fault, i.e., signs of overload, picture tearing and so on, and I first attacked the problem along these lines. However, by the time I had removed the chassis from the cabinet the set's behaviour was somewhat improved, then it became erratic again. So, whatever it was, it was intermittent.

I soon realised that the AGC idea was wrong, partly because all the symptoms did not add up and partly because I remembered that this make of set, and this model in particular, had always been much more sensitive to line voltage variation than the average run of sets.

This led, in turn, to measurement of the HT voltage. It proved to be marginally down—about 15 volts—on normal, but, much more significantly, began to waver while I watched it. A little gentle tapping on the chassis aggravated the situation and dropped the HT by as much as 50 volts. Under these conditions the set behaved much as it had when I first encountered it

At this point, I became suspicious of the thermistor in the secondary circuit of the power transformer, used to protect the rectifiers from switch-on surges. Sure enough, shorting it out with the blade of a screwdriver cured all the troubles and a new one put the set permanently back on the air.

As far as I was concerned, the case was unusual only in the sense that the thermistor failure was partial and not complete. Complete thermistor failures are nothing new and this brings me to the point of my argument.

Are these thermistors really necessary, or do they, by reason of their own poor reliability, create more service calls than they prevent?

Theoretically, of course, one can make a good case for their inclusion in any power supply circuit using silicon rectifiers. When a power supply is first switched on, the filter capacitors will normally be fully discharged, meaning that the rectifiers, at the instant of switch-on, will be looking into a virtual short circuit. And, while this will not last more than a few milliseconds, it represents a surge which may come very close to transgressing the diode surge ratings.

The thermistor, which has a high resistance when cold and a very low resistance when hot, is intended to limit this surge, then drop its resistance as it warms up, to the point where it will not interfere with the normal working of the power supply.

Unfortunately, the thermistors themselves seem to have proved more of a menace than the surges they were supposed to eliminate. Whenever I am called to a set fitted with thermistor, and it is suffering from loss of both picture and sound, the first thing I look at is the power supply and thermistor and, in a large percentage of cases, I find a thermistor failure.

The failure takes two general forms; a crack in the body of the resistance material or a loose end connection, the latter being about three turns of 18g tinned copper wire wrapped around the end of the rod. Except in the case cited above, the failure has always been complete.

On the other hand, the silicon rectifiers which designers apparently feared would not stand the rigours of field service appear to be standing up to the job remarkably well. In fact, replacing one of these is a relatively rare experience, unless they have suffered an overload due to failure of some other component.

Nor can this high order of reliability be attributed to the thermistors, because not all designers have seen fit to use them and those sets without thermistors would appear to have no higher diode failure rate than those with them. In fact, since there are more designs without thermistors than with them, it would appear that the diodes are quite capable of looking after themselves.

On the face of it, then, it would appear that the thermistor was fitted to protect the set from a potential failure which has turned out to be largely unsubstantiated but, in the process, has actually reduced the order of reliability by reason of its own weakness.

As a further support for these comments, I quote the case of a colleague who feels even more strongly about these devices than I do. Whenever a thermistor fails he simply removes it and shorts the terminals together. He maintains that this is not only quicker and cheaper, but actually improves the reliability of the set. What's more, he claims that in nearly four years since he first discarded one of these, he has never had a call back on this account.

And, while one may hesitate to adopt or recommend such a policy, the significance of the experience certainly cannot be ignored.

A parallel case which seems to throw further doubts on the reliability of these devices is their use in projectors to protect the lamp from switch-on failure.

Since projector lamps are expensive, their owners were delighted when the thermistor first appeared with the promise of an end to premature lamp failures. More recently, however, my impression is that these same enthusiasts have gone quite cold on the idea. It seems that the percentage of failures of the thermistors was high enough to constitute quite a serious nuisance.

Summing up, then: Is the thermistor in the TV set really necessary and, if it is, how is it that so many sets appear not to need it?

If it is necessary, what about some better quality versions which will remain in one piece?

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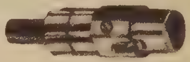

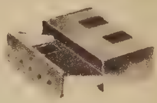

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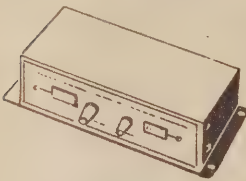

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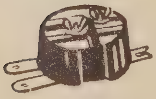

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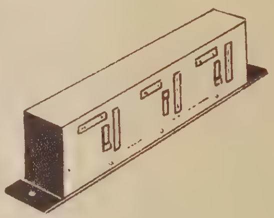

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by Michael Meechan

IN this era of space communications, telemetry, automatic sending and receiving, and the increasing use of radiotelephone transmissions, Morse code, as a means of communication, is gradually receding into the background.

However, it still conveys a large proportion of the traffic handled daily on international radio networks, in maritime services, Press services and the like, and every country in the world has several stations open for the reception of Morse code messages.

Although to a much lesser degree, Morse is also transmitted on certain amateur bands. In fact, to enjoy the use of the full range of bands available to the amateur service, one must hold a Full Privilege Amateur Station Licence and one of the requisites of being granted such a licence is to be proficient in both sending and receiving Morse at 14 words per minute (wpm).

In order to prepare for, and pass, this examination, considerable practice is necessary and this oscillator is ideal for the purpose.

It is possible to use a buzzer for this purpose, but this presents problems, since good high-frequency buzzers suitable for Morse practice are not easily obtainable and, in any case, are rather expensive. Normal domestic door buzzers are only good at low speeds; at higher speeds their reaction is too slow to follow the keying, resulting in the characters being ill-defined and difficult to read. A much better arrangement is to do as we have done and key an audio oscillator, which gives a much cleaner tone and, therefore, easier to read characters.

The operation of this circuit depends upon the rather unique properties of the unijunction transistor. As its circuit symbol would suggest, the unijunction is quite a different device from normal two-junction transistors. In fact, it is closer to a diode than a transistor and has sometimes been called the "double-base diode."

PARTS REQUIRED

1	*Base board 12 in x 6in x ½in.*
1	*5in loudspeaker (see text).*
1	*Morse key.*
1	*2N2160 unijunction transistor.*
1	*4.7K resistor.*
1	*.22uF capacitor.*
1	*Miniature closed circuit jack.*
1	*9V battery and connector.*
1	*6-lug miniature tag strip.*
4	*¾in long x ¼in dia. tube for speaker mounting pillars and four suitable woodscrews, aluminium for phones jack and battery brackets plus six suitable woodscrews, 2 woodscrews for morse key mounting, hook-up wire.*

In construction, the unijunction consists of either a small rectangular bar or cube of N-type silicon material, with a non-rectifying or "ohmic" connection at each end. The bar or cube is termed the "base" because of its similarity to the base wafer of a normal transistor and the two connections are labelled B1 and B2.

To the side of the bar or cube between the two base connections is alloyed a pellet of P-type silicon material, forming a single P-N junction —hence the name "unijunction." The P-type pellet is called the emitter and its connection labelled E.

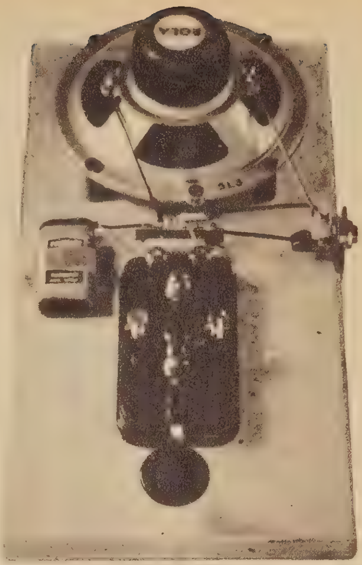
Either of the two base connections of the unijunction may be used together with the emitter connection as a normal rectifier diode, which will conduct if the emitter is made more positive than the base, but will become a virtual open-circuit if the base is more positive than the emitter. However, a voltage applied across the base by making B2 positive with respect to B1 gives the emitter-base P-N junction an inbuilt "delay bias."

This is because current flowing through the base from B2 to B1 sets up a voltage drop in the N-type material and raises the potential of the base region in the immediate vicinity of the junction. Thus as far as the emitter is concerned, the base becomes positively biased, and conduction through the junction cannot take place until the emitter is raised above the effective base potential.

But the unijunction is more than a diode with "built-in bias," for as soon as the emitter is raised above the effective base bias potential to start conduction through the junction, it injects minority carriers (holes) into the N-type base material. These have the effect of increasing markedly the conductivity of the base region between the junction and B1 and the resistance of this region drops sharply.

Because of the drop in resistance the current between B2 and B1 increases and current amplification occurs because the increase in B2-B1 current is considerably greater than the small emitter-base current. Not only this, but the fall in resistance of the junction-B1 region produces a falling voltage with INCREASING emitter-base current — so that the effective input resistance of the emitter-base junction is NEGATIVE.

Because of its ability to act as a high current-gain switch and as a negative resistance the unijunction is finding increasing use in triggering and relay circuits, in pulse shaping circuits and in many types of oscillator.



Showing how the components are laid out on a piece of board measuring 12 x 6in.

The oscillator circuit used in our little Morse Oscillator is one for which the unijunction is ideally suited. It is a "relaxation" circuit, very similar to the "neon bulb" oscillators used in some electronic organs and the thyratron time-base oscillators used in early oscilloscopes.

The operation of this circuit is quite straightforward. When the key is pressed, the 9V battery is connected across the unijunction and also across the series-connected 4.7K resistor and 0.22uF capacitor.

As soon as the voltage is applied across the base of the unijunction it draws a small current (only a few milliamps), and immediately sets up the "built-in bias" to which we referred earlier. However, the voltage at the emitter cannot rise immediately, because the 0.22uF capacitor has to charge through the 4.7K resistor.

As the capacitor charges, the voltage at the emitter will rise in the usual exponential fashion—until it just exceeds the "inbuilt bias" in the base of the unijunction. When this occurs the unijunction will suddenly conduct.

The sudden conduction does two things: first, it sends a pulse of current through the speaker or phones; and secondly, it discharges the 0.22uF capacitor. However, as soon as the capacitor is discharged, the emitter current falls to a very low figure and the unijunction turns off. When this occurs the capacitor immediately starts to recharge again through the 4.7K resistor, and the cycle of events starts over again.

The frequency with which the events are repeated as an "oscillation" depends mainly upon the time taken for the capacitor to charge to the inbuilt bias voltage of the unijunction — in other words, on the time-constant of the resistor and capacitor. The larger the resistor (or capacitor) the slower the charging and the lower the frequency of oscillation; conversely, the frequency may be increased by reducing the value of the resistor or capacitor.

The limiting values which these components may take depend either upon the ratings of the unijunction or the current levels necessary to maintain oscillation. Too high a value of resis-

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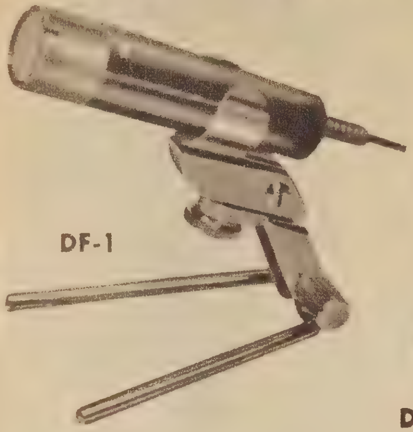
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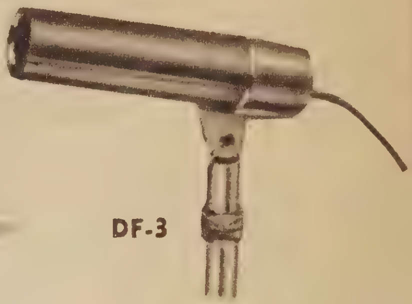
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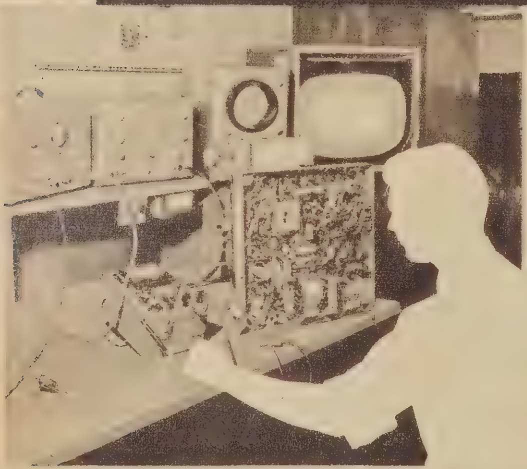

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tance will prevent oscillation because of leakage effects; too low a value will similarly prevent oscillation by keeping the unijunction "on" all the time. With this circuit the resistor should be kept above 3.3K, with the upper limit determined simply by finding the largest value with which the circuit will oscillate. The value of 4.7K shown will give a tone of about 800cps.

Too small a capacitor value stops oscillation because the stored charge is insufficient to turn the unijunction "on." Too large a value could damage the emitter-base junction of the unijunction. With this circuit, keep the capacitor value below about 2uF.

We were particularly impressed with the simplicity of this circuit, consisting merely of a unijunction transistor, resistor and capacitor, and its ability to drive either a loudspeaker or set of headphones with good results.

A point to note here is the voice coil impedance of the loudspeaker to be used. Either a 15 or 33 ohm version may be used, slightly louder volume being produced by the 33 ohm type. However, the 15 ohm version gives a perfectly audible output, but it is not advisable to go below this value, as this results in a severe drop in output.

Headphones can be used but, for high impedance types, it will be necessary to put a resistor in parallel with them in order to achieve any appreciable level of signal. We used 200 ohms in our arrangement which gave us a nice comfortable level and is as good a place to start as any, the ultimate choice depending on personal requirements.

Now for the constructional details. The whole assembly is mounted on a piece of ½in board measuring 12in by 6in, the layout being as shown in the photograph.

The loudspeaker is mounted centrally at the rear of the board on four ¾in long by ¼in diameter tubular pillars, and held in position by four suitable woodscrews.

Mounted between the loudspeaker and the Morse key is a 6-lug miniature tag strip on which is soldered the unijunction transistor, the .22uF capacitor and the 4.7K resistor.

On the right-hand side, and supported by an aluminium bracket screwed to the side of the base board, is the headphone jack, which, with the headphones inserted, cuts out the loudspeaker.

The 9V battery on the left-hand side of the board is held in position by an aluminium bracket screwed to the base board. The positive lead of the battery is taken to the Morse key, the negative lead going to the tag strip and one side of the .22uF capacitor. The Morse key is mounted centrally on the base board in the position shown.

With the layout and wiring completed, the oscillator should produce an audible tone from the speaker, or headphones, with the key pressed.

However, our real objective lies ahead: to learn the code and achieve speed and accuracy in both sending and receiving. There is no easy way to master this subject, just practice, and lots of it! However, as with all things, there is a right and wrong way to go about learning the code and the following suggestions are designed to start the student off on the right foot and make things a little easier than they might otherwise be.

As a first step, and as a handy reference, we have included a copy of the code in this article, and it will be noted that the letter itself is written after the actual sound.

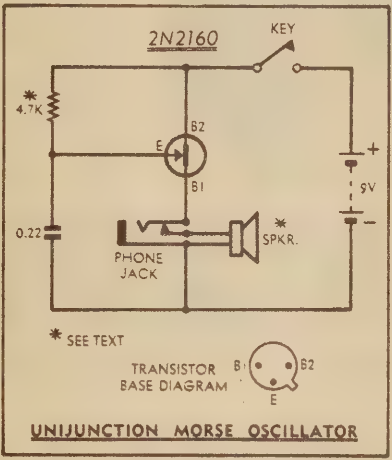
Before attempting to either send or receive Morse, the student must first memorise the code.

Don't try to learn it by saying that A is dot dash, B is dash dot dot, etc. Besides being very boring, it is the wrong way to learn the code and it won't produce real progress.

The student should learn that "d' dah" means A and not that A is "d' dah." Start the job of memorising the code in the following manner:

"d' dah"—A.
"dah d' d' dit"—B.
"dah d' dah dit"—C; etc.

Dashes are called "dah" and dots are called either "d' " or "dit," depending upon their relative position in the symbol. For example, if a symbol ends in a dot, the dot is called "dit." If the dot precedes a dash or another dot, it is called "d'."



This circuit diagram illustrates the simplicity of the device which is low in cost to build.

The object of this treatment is to give an impression of the sound and rhythm of the code by means of the printed page. By this method it is possible to learn how each symbol would sound on a practice oscillator, even although the student has never heard one.

When the code has been memorised, and to check progress, take a book, newspaper or magazine, and go through sections of text in code. In this way, each letter, figure and punctuation mark will be encountered and will prove to be both interesting and helpful. Mentally practise on advertisements, newspapers, or anything else that presents itself whilst travelling on the bus or train. It's surprising how fast this will help in building up speed.

If possible, try to practise with one or more other students, taking turn about at receiving and sending. This way, interest is maintained for longer periods and greater benefit derived from the available time. Practising alone can be very disheartening and boring.

Two services currently offered to code students by the Wireless Institute of Australia are to be recommended.

The first is run by the New South Wales division and is a Morse tape loan service. The tapes have Morse code recorded on them in a range of speeds varying from 5wpm to 20wpm, two hours on each reel. For example, No. 1 tape has one hour at 5wpm on one track and one hour at 6wpm on the other. Recordings have been made at 3¾ inches per second, but other speeds can be supplied if necessary.

To obtain the loan of any of these tapes it is only necessary to write to the Education Officer, Wireless Institute Centre, Crow's Nest, New South Wales, requesting the Morse speed required.

This service is free to anyone, whether a member of the institute or not, the only expense being 15c (1/6) per tape to cover out-of-pocket expenses and postage. Stamps to this value are acceptable as payment.

Tapes can be loaned for mutually agreed periods of time.

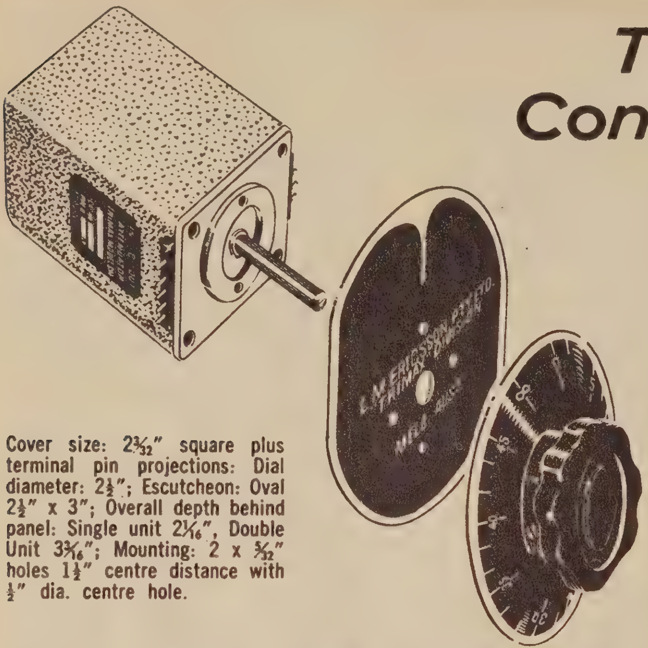
This division also transmits Morse practice sessions seven evenings a week from VK2AWI on 3550KC in the 80 metre band. The transmissions commence at 7.30pm and continue until 8pm, starting at 5wpm and increasing in easy stages to 20wpm for about the last five minutes.

Two Morse practice sessions are transmitted by the Queensland division, on Monday and Thursday evenings from 7 until 7.30. The callsign is VK4XP and the frequency 3504KC in the 80 metre band.

Both these transmissions are designed to assist students to bring their Morse up to the standard for the A.O.C.P. examination.

MORSE CODE

SOUND	MEANING
d' dah	A
dah d' d' dit	B
dah d' dah dit	C
dah d' dit	D
dit	E
d' d' dah dit	F
dah dah dit	G
d' d' d' dit	H
d' dit	I
d' dah dah dah	J
dah d' dah	K
d' dah d' dit	L
dah dah	M
dah dit	N
dah dah dah	O
d' dah dah dit	P
dah dah d' dah	Q
d' dah dit	R
d' d' dit	S
dah	T
d' d' dah	U
d' d' d' dah	V
d' dah dah	W
dah d'd' dah	X
dah d' dah dah	Y
dah dah d' dit	Z
d' dah dah dah dah	1
d' d' dah dah dah	2
d' d' d' dah dah	3
d' d' d' d' dah	4
d' d' d' d' dit	5
dah d' d' d' dit	6
dah dah d' d' dit	7
dah dah dah d' dit	8
dah dah dah dah dit	9
dah dah dah dah dah	0
d' dah d' dah d' dah	dot
dah dah d' d' dah dah	comma
dah d' dah d' dah	commence
d' dah d' dah dit	end



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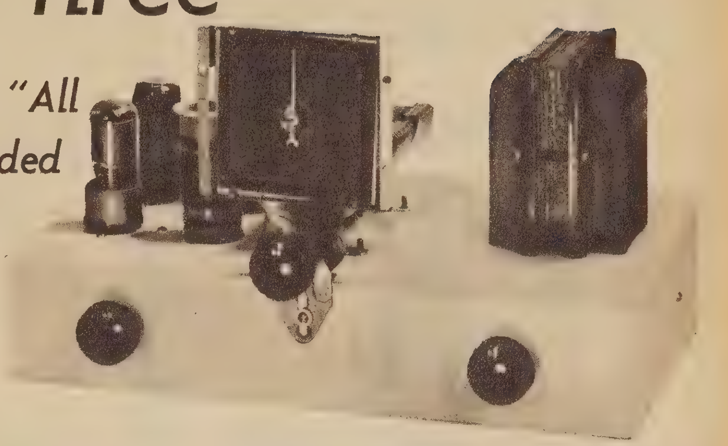
ASK FOR PAMPHLETS

The ABC-Three

—In which the title stands for "All Bits Collected". It is also intended to indicate that this beginners' receiver is as simple to build as ABC.

By Keith Woodward



Our layout is typical, but almost any convenient arrangement could be used. There is room on the chassis for a small speaker.

"TRANSISTOR projects for beginners are all very fine and no doubt satisfy many readers. Unfortunately, they usually involve a lot of new parts, and these are often too expensive for a schoolboy on a limited budget. Nobody gives away old transistor sets from which parts can be salvaged, but there are plenty of old valve sets for the asking. What about some beginners' articles using these old parts?"

This comment from one of our younger readers, prompted us to take a look at some of our older valve circuits with a view to presenting them in a form which would suit the kind of bits and pieces likely to be salvaged from old receivers.

This article — the first of what we hope will be a small series — describes a simple but effective receiver suitable for both the broadcast and short-wave bands. So, whether you want the latest hit numbers from the local stations, the overseas short-wave stations, the ships along the coast, the aircraft traffic, or just the amateur chatter, this set will fill the bill — and you'll have a lot of fun building it too!

In deciding on what to describe first, we considered a number of possibilities, including audio amplifiers and more conventional receivers. For a number of reasons, however, we decided that the first step for the beginner should be the simplest possible receiver, consistent with reasonable results.

The circuit we settled on is similar to that used for the "Basic Three" receiver featured some years ago. The circuit is the essence of simplicity and should present no difficulties, even to the beginner. It is also non-critical with regard to layout, as two stages are employed and the gain is quite low. It is also extremely flexible, allowing the substitution of a variety of parts.

Referring to the circuit, you will note that the major components and stages have been individually titled for the purpose of discussion. We shall deal with each in turn and see just what components it is possible to use and how to use them.

CHASSIS: Size is not critical and a number of chassis could be pressed into service. If an old chassis is used it should be cleaned and repainted or resprayed. Ours was fashioned from a standard blank aluminium chassis approximately 13 x 7 x 2½ inches. Another standard size is 12 x 8 x 2½ inches, and several blank chassis about these sizes are available from electronic warehouses.

POWER TRANSFORMER: The first major component is the power transformer. This item is a most likely one to be salvaged from an old receiver and will be a substantial unit for a couple of reasons. One is that old-time receivers required a fairly heavy current supply and the transformer was rarely rated at less than 60mA, which is more than adequate for our present purpose.

Another reason is that they often had to supply the power required to energise the magnetic field of an electrodynamic speaker, with which the older sets were equipped. When an electrodynamic speaker was used the secondary winding of the transformer was generally wound to supply about 385 volts, of which about 100 volts were applied to the field coil.

Besides the HT winding there are the primary and low tension secondary windings. The primary winding will most likely have several voltage taps, enabling the receiver to be used from 220, 240, and 260 volt supplies. The LT windings are to supply the filaments and heaters of the valves. A 5-volt winding will be available for the rectifier and a 2.5 or 6.3 volt one for the remaining valves, depending on the types employed.

Generally speaking, the power transformer retrieved from an old set will either be good or bad.

A close inspection will reveal whether it is in working order. Dust the transformer and the chassis in the near vicinity If the transformer does not smell and the insulation isn't charred, it is most likely in working order. However, if the transformer smells or the winding has a charred appearance or the transformer and surrounding chassis show signs of a dark "gooey" mess which has been expelled from its inside, then the transformer is most likely useless.

Let us assume, though, that the transformer is in working order.

The connections to an old-time power transformer were usually made by means of a terminal board, marked with the appropriate ratings. Cleaning with methylated spirit will reveal the figures if they have become obscured with dust and grime.

If the figures are absent or the transformer termination is with leads instead of a terminal board, try to trace the wiring prior to removal from the original chassis.

As the transformer in our prototype receiver had no terminal board we made generous use of tagstrips mounted underneath the transformer securing nuts to terminate the leads.

Use a 3-core cable for the incoming AC lead, connecting the third (green) "earth" wire to the appropriately marked lug on the transformer, which in turn, should be connected to the metal chassis. This mains lead should be securely anchored to the chassis so no strain can be put on the connections. Discard any 3-core lead that shows signs of deterioration, such as perished rubber insulation, and if any doubt exists purchase new flex. This warning applies to any electrical appliance.

RECTIFIER: Several types of rectifier may be used in this set but the most likely ones are of the directly heated type, such as the 80 and its octal equivalent, the 5Y3. The various possibilities of rectifier valves are listed in the accompanying table. Neither the filament nor the plates need to be connected to the respective windings a particular way round.

Most rectifier valves with 5 volt filaments are operated with the B-plus taken from either of the filament pins. However, in the case of the 5V4, the filament connected to pin 8 is the correct point from which the output should be taken.

If you should happen to have on hand one of the more modern miniature rectifiers, such as the 6X4, 6X5-GT and 6V4, they could be used, provided the transformer has a 6.3 volt filament winding. This can supply one of the above-mentioned rectifiers, as well as the other valves, the B-plus being taken, in this case, from the rectifier's separate cathode pin.

The rectifier socket, if salvaged from an old set, will most likely be a wafer type and must be thoroughly cleaned. If there are any signs of breakdown or charring between the pins, the socket should be discarded. Cleanliness is important for the rectifier socket, because it is subject to a considerable voltage and, together with speaker socket, would

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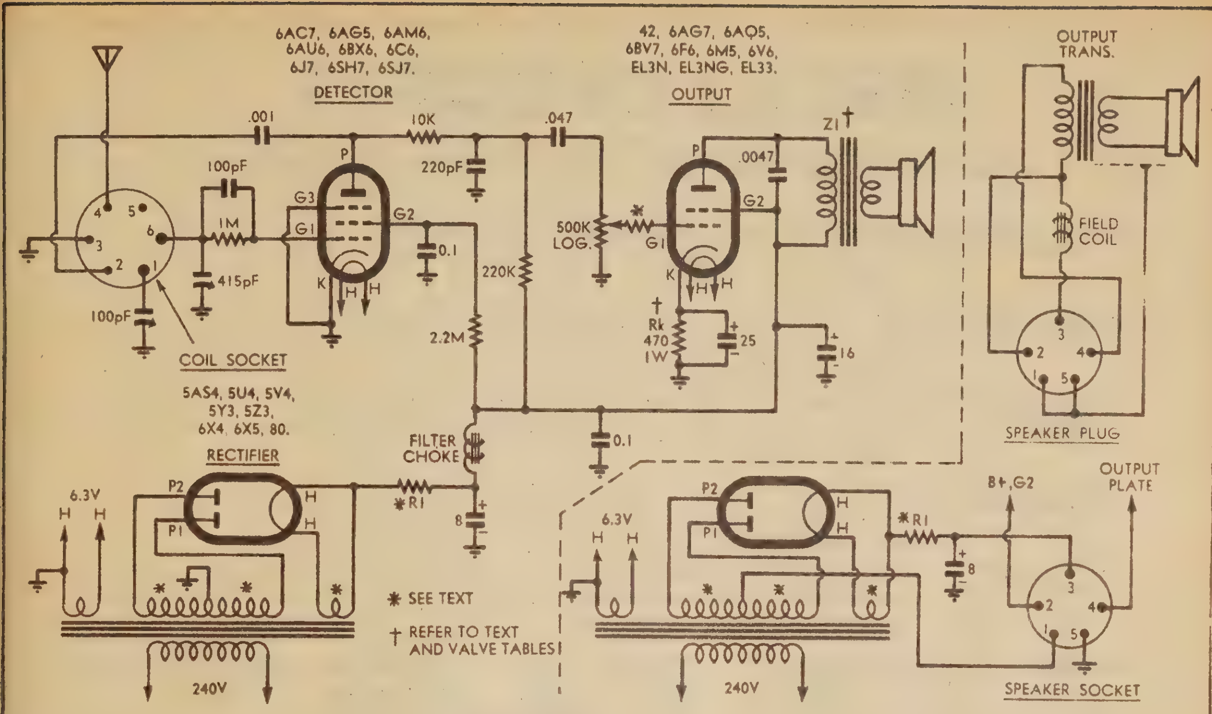
6AC7, 6AG5, 6AM6,
6AU6, 6BX6, 6C6,
6J7, 6SH7, 6SJ7.
DETECTOR
42, 6AG7, 6AQ5,
6BV7, 6F6, 6M5, 6V6,
EL3N, EL3NG, EL33.
OUTPUT
OUTPUT TRANS.
.001
10K
.047
Z1†
100pF
220pF
.0047
P
G3
G1
G2
1M
0.1
500K LOG.
*
G1
K
H
415pF
220K
100pF
FIELD COIL
COIL SOCKET
2.2M
†
Rk
470
1W
25
16
5AS4, 5U4, 5V4,
5Y3, 5Z3,
6X4, 6X5, 80.
RECTIFIER
FILTER CHOKE
0.1
SPEAKER PLUG
6.3V
P2
P1
*R1
8
B+,G2
OUTPUT PLATE
* SEE TEXT
† REFER TO TEXT AND VALVE TABLES
240V
SPEAKER SOCKET

ABC-THREE

The circuit is a conventional one, employing a regenerative detector feeding a power output stage. Two power supplies are shown, one for use with permag speakers and lower voltage transformers, and the other for older electro-dynamic speakers and higher voltage transformers.

be the first to break down if the insulation is impaired by charring or excessive dirt and flux.

Bend or tighten the contacts, if necessary, depending on the type of socket, so as to increase their grip on the valve pins.

Connection between the 5-volt winding and rectifier filament is made by means of twisted hookup wire. Since the high tension is taken from the heater, making the heater winding at the HT potential, this winding must remain insulated from chassis and other circuits. The extreme ends of the high voltage winding on the power transformer connect to the plates of the rectifier in the same manner as the heaters.

A detailed wiring diagram will allow the beginner to produce a reasonable facsimile of our receiver, with the necessary modifications to allow the use of different valves which may be on hand. Because of the various valve combinations which may be used the wiring diagram shows the valve sockets with element identification rather than pin numbers. By comparing these with the tables provided the receiver may be readily wired to suit the valves selected.

LOUDSPEAKER: This unit may have been salvaged and kept in good order or, on the other hand, it may have been exposed to the ravages of time, dirt, mice, etc. Before the speaker is used it must be thoroughly checked and cleaned. A small paint brush or a bicycle pump will prove invaluable during the cleaning process, to dislodge pieces of grit.

Finally the connecting cable should be renewed if the original shows signs of wear and tear. In the case of an electrodynamic speaker, three of the leads in this cable are carrying HT and too much stress cannot be laid on the danger of wiring becoming exposed.

More recent sets will use a speaker with a permanent magnet while the older ones will use an electrodynamic type.

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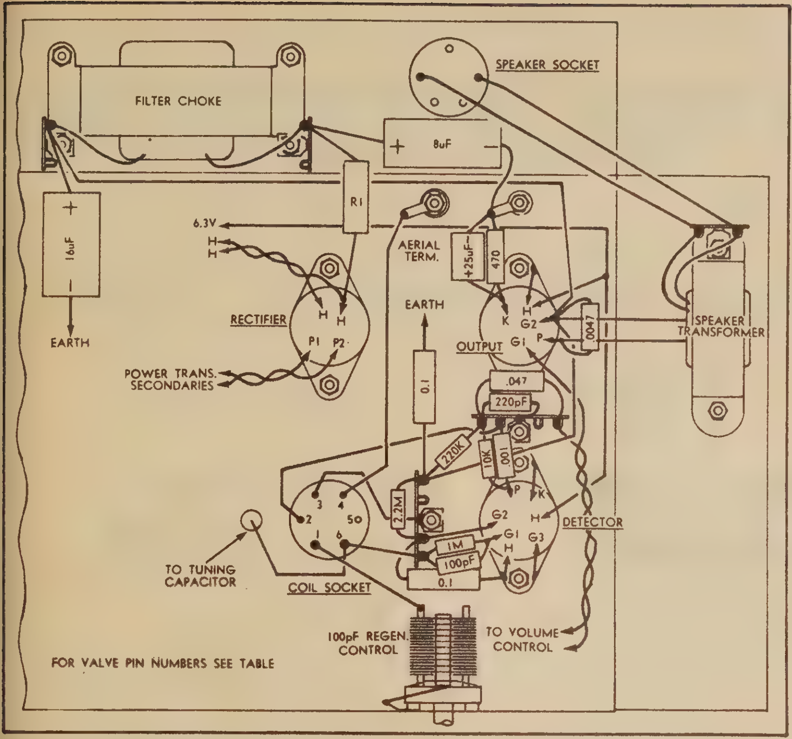

This wiring diagram will serve as a guide, but some variation is inevitable to accommodate available components.

As mentioned earlier the latter will mean that the transformer secondary will have voltages up to 385 volts either side of centre tap. If the speaker is useable then the field coil will be used in place of the filter choke used with permanent magnet speakers. Two power supply circuits are shown in the circuit diagram with details for the two speaker types. When a electrodynamic speaker is used the resistor R1 may not be necessary.

The value of the resistor will depend on the applied voltage from the secondary winding, the DC resistance and impedance of the field coil or filter choke and the current consumption of the receiver. This makes it very hard to state a definite figure for the resistor. However, it will not matter if you err on the high side as the receiver is not very voltage conscious and will work on voltages down to 175 volts with very little difference in performance. Our original transformer gave a secondary voltage, under load, of 300 volts and a 1.5K 5-watt resistor reduced this to approximately 235 volts.

With a 385-volt secondary and a field coil of 2,500 ohms a 1K resistor should give reasonable results. With field coils of 1,000 to 1,500 ohms the resistor should be increased to about 2,000 ohms.

VALVE DATA

RECTIFIERS

Type	Filament Volts	Max. Sec. Volts	Connections 1	2	3	4	5	6	7	8
5AS4	5 volts	450	NC	F	—	P2	—	P1	—	F
5U4	5 volts	450	NC	F	—	P2	—	P1	—	F
5V4	5 volts	375	NC	F	—	P2	—	P1	—	F/K
5Y3	5 volts	350	NC	F	—	P2	—	P1	—	F
5Z3	5 volts	450	F	P1	P2	F	—	—	—	—
6X4	6.3 volts	325	P1	NC	H	H	NC	A2	K	—
6X5	6.3 volts	325	NC	H	P2	—	P1	—	H	K
80	5 volts	350	F	P1	P2	F	—	—	—	—

OUTPUT VALVES

Type	Connections 1	2	3	4	5	6	7	8	9	Rk (ohms)	Zl (ohms)
42	H	P	G2	G1	K	H	—	—	—	470	7,000
6AG7	S	H	IS	G1	K	G2	H	P	—	100	10,000
6F6	NC	H	P	G2	G1	—	H	K	—	470	7,000
6V6	NC	H	P	G2	G1	—	H	K	—	250	5,000
EL3N	NC	H	H	K/G3	NC	G1	G2	P	—	150	7,000
EL3NG	NC	H	P	G2	G1	—	H	K/G3	—	150	7,000
EL33	NC	H	P	G2	G1	—	H	K/G3	—	150	7,000

DETECTOR VALVES

Type	Connections 1	2	3	4	5	6	7	8	9	TC
6AC7	S	H	G3	G1	K	G2	H	P	—	—
6AG5	G1	K/G3	H	H	P	G2	K/G3			—
6AU6	G1	G3/IS	H	H	P	G2	K	—	—	—
6C6	H	P	G2	G3	K/IS	H	—	—	—	G1
6J7	S	H	P	G2	G3	—	H	K	—	G1
6SH7/6557	S	H	G3	G1	K	G2	H	P	—	—

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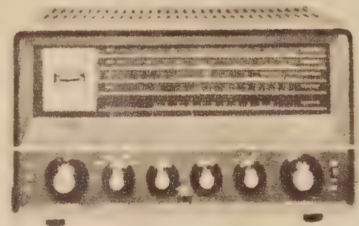

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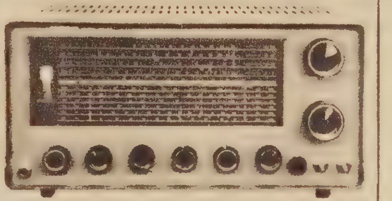

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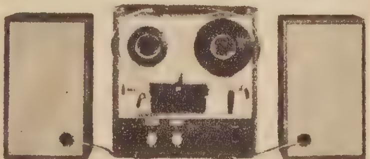

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Even if the speaker itself is beyond redemption, but the field coil is in good order, it can still be used in the power supply circuit to save the expense of a filter choke and resistor to replace it.

FILTER CAPACITORS: A filter capacitor is connected to the end of the resistor opposite the rectifier filament. An 8 or 16 mfd unit is suitable and must have a voltage rating of 500.

At this stage, a word of warning. Do not in any circumstances use electrolytics salvaged from an old receiver. Their capacitance will be low and their leakage may have deteriorated sufficiently to endanger the rectifier and perhaps the power transformer. A pair of new capacitors is almost essential.

If an electrodynamic speaker is used it is a wise precaution to use a 5-pin speaker plug. Two pins of the plug can then be strapped together and will bridge the two matching points of the socket. One of these socket connections will go to the chassis, the other to the centre-tap of the secondary winding. This is a safety precaution to stop high surge voltages being applied to the first electrolytic capacitor should the speaker be inadvertently disconnected.

In the older sets it was the usual practice to mount the speaker transformer on the speaker housing. In our receiver we used a permanent magnet speaker and elected to mount the speaker transformer on the chassis. In any case, the speaker transformer should, for optimum results, match the speaker to the output valve selected. The correct impedance for typical output valves is given in our table.

OUTPUT VALVE: Next in our logical progression is the output valve. This could be one of a number of types, but the most likely ones are listed in our table. A cathode resistance of 470 ohms is shown in our circuit diagram and this will be high enough for all the valves listed. However, if maximum efficiency is required, then this value may be adjusted according to the output valve table.

In the European series of valves, those starting with letters in the type number, best results will be obtained by using the recommended value of bias resistor. Due to their sensitivity these valves are sometimes prone to parasitic oscillation and may require a grid stopper resistor ranging in value from about 10K to about 47K. This grid stopper is inserted in series with the lead running from the potentiometer to the grid, and as close to the grid pin as practicable.

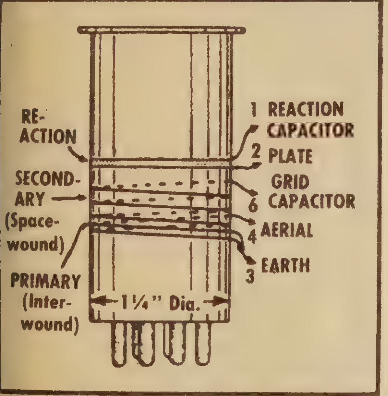
One side of the heater wiring for both the output valve and the detector valve is connected to the chassis. Either a single lead for the active side of the heaters may be run from the transformer or a twisted pair may be used. In the former case the return path for the heaters is through the chassis.

The volume control in the grid circuit of the output valve is a standard potentiometer and is not very critical in value. Any unit with resistances ranging from 250 to 500K will be suitable.

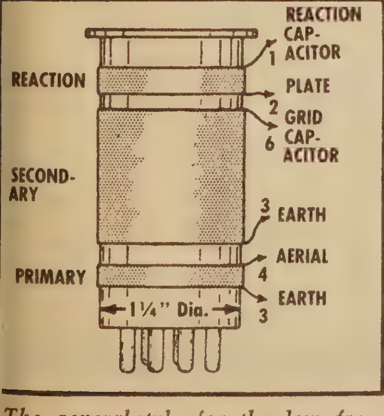
DETECTOR: Next we come to the

COIL DATA

BAND	AERIAL PRIMARY	SECONDARY	REACTION
570KC to 2MC (Broadcast Band)	15T. 32 SWG Enam. Spaced 3/16in from earthed end of secondary.	100T. 32 SWG Enam. Close wound	40 - 60T. 40 SWG Enam. Spaced ⅛in. from grid end of secondary.
1.18 to 4.7MC	11T. 32 SWG Enam. Spaced ⅛in from earthed end of secondary.	38T. 25 SWG Enam. Close wound	20 - 35T. 32 SWG Enam. Spaced ⅛in. from grid end of secondary.
2.9 to 11.2MC	5T. 32 SWG Enam. Spaced 1/16in from earthed end of secondary.	13T. 25 SWG Enam. Spaced to occupy ½in.	9 - 15T. 32 SWG Enam. Spaced ⅛in. from grid end of secondary.
8.2 to 30MC	1T. 32 SWG Enam. Interwound from earthed end of secondary.	4T. 25 SWG Enam. Spaced to occupy ½in.	4 - 6T. 32 SWG Enam. Spaced ⅛in. from grid end of secondary.



The general style of winding for high frequency coils.



The general style for the low frequency close wound coils.

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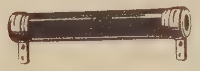
 Vitreous coated Wire wound 1.5 to 14 watts. Bulletin RWV.621A	 Tubular, fixed and adjustable Wire wound 3 to 200 watts with "Pyrosil" coating. Bulletin PRS.62A	 High voltage and High frequency Resistors up to 100 kV, 90 watts. Lead, lug and ferrule types. Bulletin MPMV62A
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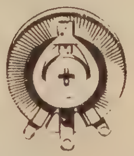
 Sliders Wire wound 50 to 200 watts. Bulletin SLS.62A	 Flat Wire wound with "Pyrosil" coating 20 to 75 watts. Bulletin FRW(a)	 Variable Wire wound 2 to 100 watts. Bulletin PRA65A

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etector stage. This is a straightforward egenerative circuit, in which reaction is ontrolled in the plate circuit of the valve y means of a variable capacitor.

A large number of valves can be used n this position, a few of the more ommon ones being listed in our table. he valves need not be new, for as long s they are pronounced "fair" on a valve heck they will most likely function.

At this stage we feel that beginners hould obtain a valve manual of some ype which lists the characteristics of alves and their base connections. These re available from valve manufacturers nd technical bookshops, the prices anging from 2/6 (25c) to 25/ ($2.50), epending on the presentation.

We have now reached the tuned circuit. 'or the purpose of discussion we shall reak this up into three sections: (1) the oil, (2) the reaction capacitor, and (3) he tuning capacitor with the dial.

COIL: The coil may be a standard einartz, for the broadcast band, bought ver the counter of the local radio wareouse. For wider coverage we have suplied details of handwound coils which nay be plugged into a 6-pin socket and over frequencies up to 30MC. A third pproach would be the alteration of an xisting aerial coil to provide regeneraion.

In the latter case it will be necessary o identify the aerial and grid windings nd ascertain if there is sufficient room o add the third winding for reaction. f the former is too short it may be ecessary to increase its length with a hort tube of cardboard firmly attached. 'he data for the reaction winding may e taken from our plug-in coil table and hould give satisfactory results.

REACTION CAPACITOR: This is a mall, variable unit of about 100pF capaitance. As this capacitor has to be conrolled separately it will not be possible o use the second section of a two-section uning capacitor. The majority of sets ikely to be used for our purpose do not ontain this item and it will be necessary o purchase it.

TUNING CAPACITOR AND DIAL: t is usually possible to salvage a two- or hree-gang tuning capacitor in reasonably ood condition. The gang should be examned for bent and corroded plates. The nsulators should be clean and free from nechanical damage. Only one section eeds to be in good order.

Values of tuning capacitors may vary lightly, but this is not critical, provided he value is in the vicinity of 400pF.

TUNING DIAL: If the dial has tation callsigns or KC marking on it, t should ideally be matched to the gang. On the other hand, it should be possible o calibrate a suitable card and attach his over the old calibrations.

Having completed the mechanical vork and the electrical wiring, it now emains to switch the set on and coax t to life.

The set should be switched on withut any valves at first, just in case. If here is any sign of smell or smoke, or he transformer getting hot, it should mmediately be disconnected, and the viring rechecked for errors. If the transormer still shows signs of distress, then t should be discarded.

If all is well plug in the detector alve and output valve but not the recifier. These two valves should light up, f not switch off and check the heater viring. Finally, with the speaker attached, plug in the rectifier valve. Watch the set very carefully for any signs of distress as the rectifier warms up. If the plates of the rectifier should start to go red switch off immediately and check the high tension wiring for a short or partial short to chassis.

Attach the aerial and earth to the set and it should now be possible to tune in a station with the reaction capacitor plates about one-third in mesh. If the station is weak try advancing the reaction slowly until it is just below the point of oscillation. This will increase the volume and selectivity.

If the set should refuse to oscillate, even with the reaction capacitor fully meshed, try reversing the connections to the reaction winding. If this does not help revert to the original condition and try adding some turns to the reaction winding until the set goes into oscillation with the reaction capacitor plates about one third to one half meshed.

PARTS LIST

1 Chassis approx. 13 x 7 x 2½ ins.
1 Power Transformer.
1 Speaker with transformer to suit output valve.
1 Coil or set of coil formers.
1 Tuning Capacitor and Dial.
3 Valves and Sockets to suit.

For more specific information on the above components refer to the text.

1 100pF Reaction Capacitor.
1 16uF 500VW Electrolytic.
1 8uF 500VW Electrolytic.
1 25uF 25VW Electrolytic.
2 .1uF 400VW Plastic or Paper.
1 .047uF 400VW Plastic or Paper.
1 .0047uF 400VW Mica or Paper.
1 .001uF 400VW Mica or Plastic.
1 220pF 400VW Mica or Plastic.
1 100pF 400VW Mica or Plastic.
Resistors (¼ watt unless specified)
1 2.2 meg.
1 1.0 meg.
1 220K.
1 10K.
1 1.5K 5 watt, see text.
1 470 ohm 1 watt, see text.
1 500K potentiometer, audio taper.

SUNDRIES: Hookup wire, tinned copper wire, enamelled wire for coils, tagstrips, nuts and bolts, solder lugs, solder, mains lead and plug, rubber grommets, 3 knobs and 2 spring terminals.

Similarly, if the reaction cannot be controlled remove turns from the reaction winding or space it further from the tuned winding.

As this is a simple set, with relatively low gain, a good aerial system should be used especially where the nearest radio stations are a fair distance from your residence. The aerial could consist of a length of wire, approximately 30 or more feet, strung to a nearby tree or pole, or in some way where it will not be a hazard to pedestrian traffic.

In closing, we will give a little warning: once it has been established that the set is capable of oscillation, it should not be allowed to oscillate indiscriminately. Besides causing severe distortion from the speaker, it will be a source of annoyance to neighbours. ■

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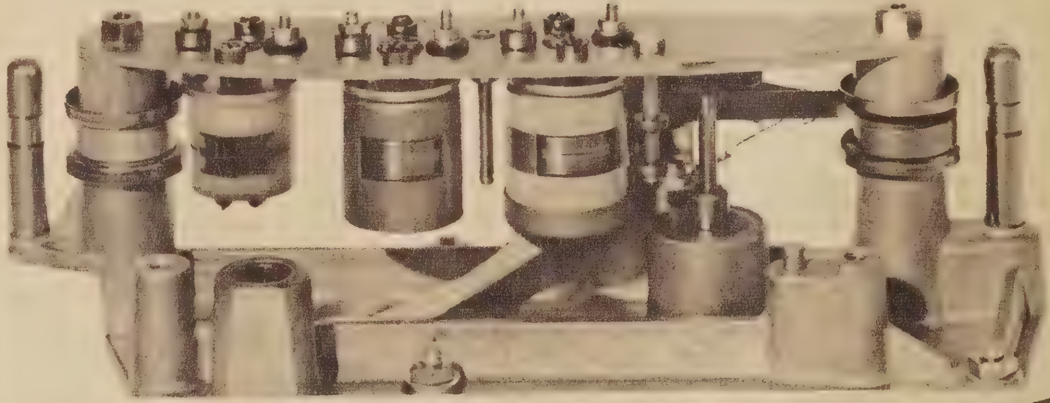

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AUDIO TOPICS

Filling for vented enclosures, labyrinths

Compact loudspeaker enclosures, fully sealed and filled with a light, absorbent material, are continuing to find acceptance among high fidelity enthusiasts. Speculation appears to be developing now about the possible value of the filling technique in relation to other types of enclosure.

by Neville Williams

COMPACT, fully sealed enclosures are by no means new in concept. or many years, certain manufacturers ave offered 8-inch or 10-inch loudpeaker units having very low fundaiental cone resonance, typically around 0cps, and with a suspension system nd voice coil length which envisages onsiderable cone excursion. When iounted in fully sealed, and fairly ompact, padded enclosures, the loudpeakers exhibit a loaded cone resonance ı the 50cps region, with good response own to, and somewhat below, this igure.

This class of loudspeaker has long ad its faithful followers but never won majority preference. The fashion of he day was a large — usually 12-inch —loudspeaker, exhibiting relatively high coustic efficiency and mounted in a enerously proportioned reflex, labyrinth, orn or other type enclosure. And with mono system, this did not present an npossible situation for the avid highdelity enthusiast.

With the coming of stereo, the foresaid average enthusiast simply had › find an alternative to two large nclosures, if possible without giving nything away in terms of quality.

With this need came the gradual ealisation that it wasn't necessarily mart to demand for the living-room a udspeaker and amplifier system that ould as easily serve a public hall! That mple level for practical, enjoyable stening could be provided by smaller nd perhaps less-efficient loudspeakers iounted in smaller enclosures.

And with stereo, there are two mplifiers and two loudspeaker systems, nyway, to share the task.

This general thinking created a much iore favourable climate for the sealed nclosure idea, except that the new ersions which emerged to meet the ereo challenge went further, in many ases, than the earlier varieties.

In an effort to get enclosure size ght down, while still retaining good ass response, designers used very small udspeakers — down to 3 or 4 inches diameter — with long-travel voice ils and heavy sacrifice both in terms acoustic efficiency and ultimate oustic power output.

Goodmans probably defined the limits ry neatly with their tiny "Maxim" iit. Other designers settled for someing yielding higher efficiency and outt but at the expense of greater enclosure dimensions. (Our "Playmaster Bookshelf" system is typical.)

A feature of the present generation of sealed enclosures is that nearly all have the air space within occupied by a very light-textured filling material. We specified "Innerbond" or lightweight Fibretex battes while others have used glass-wool or natural wool fibres. In some cases, it is poured in before the rear lid is screwed on, with a cloth overlay around the loudspeaker to keep it away from the actual cone.

It can readily be demonstrated that such filling material lowers the natural resonance of the system by up to 15cps and reduces its amplitude as well. It also kills any colouration produced by sound bouncing around inside the enclosure and emerging through the paper cone of the loudspeaker.

Those with a mathematical bent can translate the various loudspeaker and enclosure parameters into an equivalent electrical circuit and invoke well-known formulas to show that the presence of acoustic resistance (notably the filling material) lowers the resonance. This checks with observed fact but is not very graphic to those less mathematically inclined.

A writer in an overseas magazine has suggested a concept which some may find helpful. He points out that the mass of very fine fibres inside the box tend to divide the airspace into millions of "compartments," all freely interconnected. When air is set in motion by a sound wave, it has to sift its way through these compartments and, in so doing, tends to carry the fibrous mass along with it.

In effect, this adds mass and viscosity to the air so that the cone finds itself operating, not just upon air within the enclosure, but upon something that is more viscous and heavier than air. The resonant frequency of the system is lowered, as a result.

This ability to lower the enclosure resonance is subject to the proviso that the filling material does not substantially reduce the effective volume of the air space, otherwise one effect cancels the other. It checks with our own findings that dense, bulky material like carpet underfelt is quite unsuitable. It also points up the distinction in concept between filling the enclosure as described and the older technique of merely padding the inside faces.

Not surprisingly, all the talk about filling and filling materials has raised in people's minds the question as to whether the technique may have something to offer to reflex and other enclosures. After all, not everyone has loudspeakers to suit the sealed enclosure technique and not everyone has to shrink enclosure size quite so drastically.

As far as reflex enclosures are concerned, a very considerable amount of work has been done with such devices as pads around the rear of the loudspeaker, "curtains" and subdivisions within the enclosure and acoustic resistance units across the port. This work has been variously aimed at diminishing echoes within the enclosure, diminishing the size of the enclosure, the amplitude of the twin resonance peaks and the distortion content.

The measures have been variously effective but some have expressed the opinion that light density filling material may turn out to be the most effective measure of all. They reason that the kind of vented enclosure that borders on the dubious, because of its limited dimensions, might be "doctored" to produce a much more acceptable result. It would end up as a kind of half-way house to the compact sealed enclosure but with less drastic effect on cone resonance and some low-frequency yield from the port.

In the January 1966 issue of "Hi-Fi News," J. R. Ogilvie describes some work done in conjunction with Bakers (Selhurst) Radio Ltd., on small reflex enclosures. He nominates as a cheap and satisfactory filling fine grade woodwool "often used as a packing material for chinaware." (This does not necessarily indicate, by the way, that the material would be suitable for our Bookshelf system, though its reported cheapness would be attractive where a large volume is required to be filled.)

The labyrinth type of enclosure, often referred to wrongly as a folded horn, is one in which the rear wave from the loudspeaker cone is forced to follow a devious path (or folded tube) constituted by a series of shelves and baffles inside the box, and emerging into the open air several feet later!

The difficulty with the system is that, in a structure of convenient (?) size, it is hard to provide a tube which, at the one time, has sufficient cross-section and sufficient length. By too heavily loading the rear of the cone, it can push up the natural cone resonance unduly (like a too-small sealed box) while the energy that does emerge from the tube may have an unfortunate phase relationship with that from the front of the cone.

In "Wireless World" for December,

(Continued on page 107)

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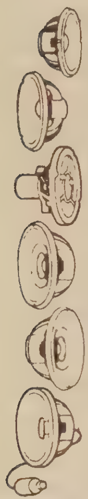

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Classical reviews

By JULIAN RUSSELL

Gotterdammerung: Year's Best

Wagner-Gotterdammerung. Complete Music Drama. Birgit Nilsson (Brunnhilde); Wolfgang Windgassen (Siegfried); Gustav Neidlinger (Alberich); Gottlob Frick (Hagen); Claire Watson (Gutrune); Dietrich Fischer-Dieskau (Gunther); Christa Ludwig (Waltraute); Lucia Popp, Gwyneth Jones, Maureen Guy (Rhinemaidens); Helen Watts, Grace Hoffman, Anita Valkki (Norns). The Vienna State Opera Chorus and the Vienna Philharmonic Orchestra conducted by George Solti. Decca Stereo SET292/7.

If I were asked to name the recording industry's finest achievement in 1965 I should unhestitatingly choose this Decca set. And I can state many reasons for my choice. Although Decca — and producer John Culshaw — have given us excellent "sonic stage" sets in the recent past, none has been on the grand scale of Gotterdammerung in size of cast or duration of music to be rehearsed and recorded. The actual playing time of the six discs is about 4½ hours and I defy anyone to spot where one take ends and the next begins.

"Sonic stage" has offered us fine, even superb sound, before, but this time Culshaw has excelled even his own high standard in quality of sound, balance, presence, and imaginative touches that bring to the mind's ear and eye dramatic and atmospheric effects conceived by Wagner but immensely difficult to bring off in an opera house. In fact, in productions at Wagner's own Bayreuth, mounted by his two grandsons Wieland and Wolfgang, the tendency has been to get away from the old-time realistic productions and substitute formalised settings and gestures.

Thus, in the production of "The Ring" I saw there in 1962, gone were the streaming manes of the Valkyries' horses. Instead the daughters of Wotan lolled on a bare saucer-shaped stage, for all the world as if they were sun-baking, and turned their heads from side to side like spectators at a tennis match to indicate that they were watching their mounted sisters ride to and fro. And this was only one of many changes made by the grandsons in the spectacle as imagined, and diligently sought after, within the means to hand 100 years ago, by their illustrious grandfather.

Perhaps it might be better to allow John Culshaw himself to describe in his own words as used in his scholarly foreword to the set under review the problems facing a producer of Wagner's music dramas. He writes:

"Wagner saw his works as dramas which could only be said to exist when each and every component dropped into place. This ideal of unity is by its nature almost impossible to achieve but he never gave up the quest. He knew that even the most complicated stage directions could be made to work, given time, money and effort and he was driven mad by conductors who could see nothing beyond the pages of the score.

"Nowadays . . . quite frequently the text is rendered ambiguous or downright absurd by the omission of some action or sound demanded by the composer. It does not make much sense for Brunnhilde to enter in Act 3 of "Gotterdammerung" with the line 'Cease your cries of woe' when nobody on the stage has uttered a single squeak for fear of disturbing the music . . . We thus reach the curious situation where, as the theatre moves steadily away from drama as Wagner thought of it and so towards a static symbolism, the gramophone recording is using its aural capabilities, especially in stereo, to support the original drama."

Culshaw goes on to say that in making "Gotterdammerung" everyone associated with the production was told that the ultimate aim of their work was realisation of the drama . . . "whether expressed in terms of vocal inflection, instrumental emphasis or even sound effects." He states categorically that there was only one authority to whom he referred — the composer himself. But he goes on later to display slight anxiety about the acceptance of two scenes which might surprise listeners and court criticism from those whose memories of operatic performances are ineffaceable. These are the first and last scenes of Act 1.

Culshaw, by recording techniques, tried in Scene 1 by "built-in haziness" to produce a "slightly diffused sound which was allowed to clarify and brighten gradually during the transition to the dawn duet." Although, to my mind, Culshaw succeeded brilliantly, he was criticised in some quarters for diffusion of sound that impeded vocal clarity.

Culshaw's second "excuse" is for the scene where Siegfried, changed into the bodily form of Gunther, has to use a feigned voice when his tenor must simulate a baritone. But here again, though all overseas critics are not of the same opinion, I think that Culshaw succeeded as well as was possible, especially when it is remembered that the baritone voice to be simulated was the remarkable organ of Dietrich Fischer-Dieskau.

To those who have never seen "The Ring" Culshaw will evoke a marvellously detailed picture of everything that happens in the drama if the story accompanying the set is read carefully first, even perhaps committed to memory, and the text followed in the excellently translated libretto. And the magnitude of this achievement can be summed up by the statement that not only are Wagner's visual concepts graphically revealed but also the psychological motivation of each of the characters.

It is difficult to imagine a better cast than that assembled here for the recording. In these days, when the engagement books of leading operatic artists are filled for some two or three years in advance, the getting together of such a distinguished cast — in the small parts, too — in an opera house for a single performance would be an achievement of a generation. Dominating everyone, as he did in Bayreuth in 1962, and in Vienna, where I heard him in June last year, is Gottlob Frick as Hagen. It is a performance memorable in terms of the greatest interpreters of the role, beautifully sung, the blackness of the character formidably projected, acceptable alike in detail and in the grand sweep of its power.

Windgassen is far and away the best Siegfried singing today, better in Vienna than he was at Bayreuth, and the very top of his form in his recorded performance here. His voice is tirelessly expressive, his grasp of his character assured in every scene, his manner heroic and his delivery free of the barks and other vocal tricks that mar the performances of so many heldentenors. He even manages to get just the right touch of lightness into his scene with the Rhinemaidens.

Fischer-Dieskau is an outstanding Gunther, making that character both plausible and acceptable in his less noble aspects. In fact, he uses what can only be called a noble voice, not

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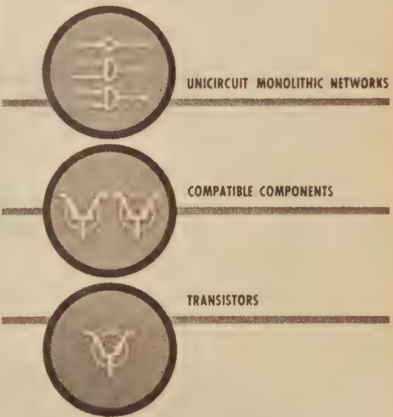

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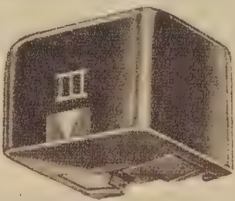
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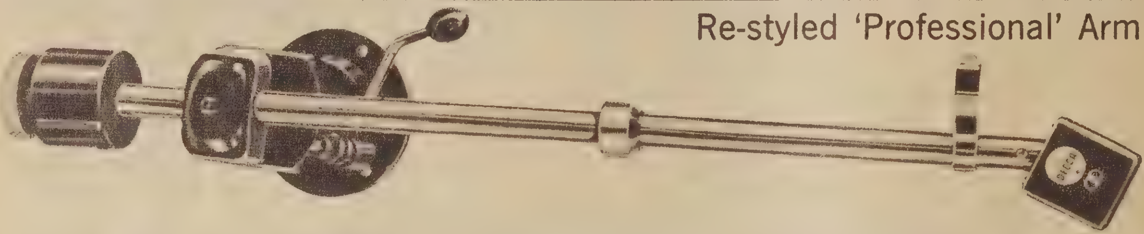

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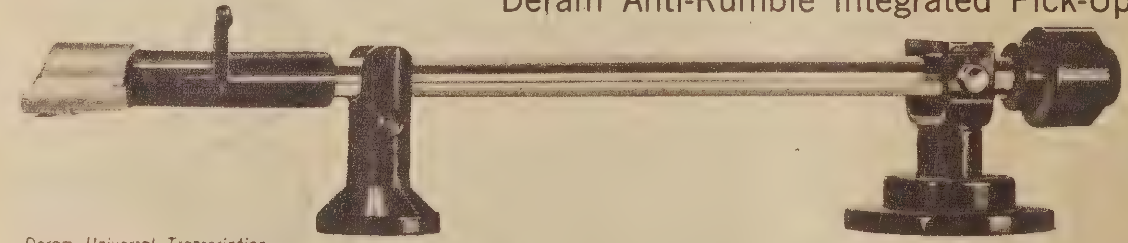

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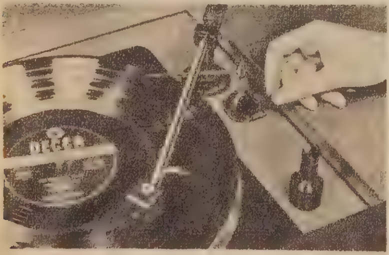

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o disguise the man's weaknesses, but o reveal them. To complete the male rincipals in the cast there is Gustav Neidlinger, splendid in hatefulness as Alberich.

The Brunnhilde is Birgit Nilsson, bout whom it might be said that she s the best available dramatic soprano or the role today, though not memorble in terms of illustrious predecessors. She presents a fully mature Brunnhilde who perhaps doesn't shine quite as adiantly as she might in her first love cene with Siegfried but moves on esolutely from there to her magnificent limax in the Immolation Scene. The Brunnhilde I heard in Vienna, Astrid Varnay, was in no way comparable, ither vocally or dramatically.

In the important role of Valtraute, Christa Ludwig uses a beautifully inflecd vocal line to express all the womanly nxiety of that friendly Valkyrie. Clare Watson makes a gentle, bewildered Gutrune, always touchingly sympathetic. The chorus in the vassal scene with Hagen is magnificently forceful, yet lways musical. The "small" parts of the Rhinemaidens and the Norns are all etter sung here than I have ever heard hem in any opera house.

We come now to the greatest star f all in this grand production — the Vienna Philharmonic Orchestra under Georg Solti. The unremitting beauty of ts tone must be heard to be believed. The artistry of its first desk soloist is nrivalled as they play here. Their joy in heir work is patent in every bar of he great score. And their conductor, xcept for an occasional slow tempo, is rodigal of his talents to everyone, the rchestra, the singers, and that fine roducer, Culshaw.

* * *

Puccini—Tosca, Complete Opera. Maria Callas (Tosca); Carlo Bergonzi (Cavaradossi); Tito Gobbi (Scarpia); Leonardo Monreale (Angelotti); Giorgio Tadeo (Sacristan); Renato Ercolani (Spoletta); David Sellar (Shepherd Boy). L'Orchestre de la Societe des Concerts du Conservatoire (Paris) and the Chorus of the National Opera conducted by George Pretre. H.M.V. Stereo AN/SAN149/50.

This set will inevitably recall to LP uyers of long standing the now famous e Sabata "Tosca" which also used Cals and Gobbi in the parts they sing gain here. Bergonzi has replaced Di tefano and Pretre — nowdays Cals' favourite conductor — de Sabata. et me say at the outset that both Callas nd Gobbi show signs of age after the nterval of 12 years and that Pretre is no e Sabata. But this is not to say that he set under review is in any way an nacceptable "Tosca." It has, on the ontrary, much to recommend it.

Gobbi, despite the loss of bloom on is still fine voice, is as good a Scarpia s can be found today. He long ago erfected his characterisation of the part, omewhat along the lines of Scotti's amous interpretation. His switches from avity to ferocity are always convincing. Moreoever, it is not until the second ct that the traces of aging mentioned bove begin to show in his voice. He nd Callas both sing the first act with estraint that made me over-opimistic bout the second. For here, the dramac emphasis necessary for a successful erformance of this melodramatic scene robs both voices of some of their music.

Callas' restraint in Act 1, her security in attacking high notes without coarseness and her still incomparable sense of character projection, all go to make her lapses in Act 2 more noticeable. An occasional top note becomes disturbingly insecure in pitch and rough in tone and, surprisingly, she only just manages to handle the climax in "Vissi d'Arte." But despite these lapses she is still able to offer a Tosca superb in her pride, imperious in her rages — rather like she is reported to be in private life — and devoted in her love of Cavaradossi.

In this last role Bergonzi provides the surprise of the performance. His voice is always sweet, his manner refined, his delivery free from tearful over-expression, his phrasing smoothly and elegantly shaped. He may not be the most forceful Cavaradossi singing today (indeed the "Vittoria" outburst in Act 2 extends him to just about his limit) but he is easily the most enjoyable I have heard since Di Stefano.

The smaller characters are all good, especially Tadeo's Sacristan, sung without the tiresome mannerisms of opera buffo, and Monreale's Angelotti, urgent in fear of recapture. A word of praise, too, for David Sellars' pure-voiced shepherd boy.

Pretre coaxes a rich tone from his orchestra, more expressive than that usually heard at the Paris Opera nowadays. But his is something of a bar-to-bar reading, each climax handled for all its worth as it comes along without thought of what might be lying just ahead. Despite this, he fails to give the sinister Scarpia theme all the baleful weight awarded it by de Sabata. He is, however, always considerate to his singers and maintains an effective balance between them and the orchestra throughout.

The sound is excellent, far more sophisticated than that in the 12-year-old de Sabata set. And the performance as a whole is likely to appeal immensely to those who revel in the work's gory plot and broadly drawn characters. And I'm not sure that Bergonzi's performance alone might not be sufficient recommendation to make it attractive to more discerning buyers.

* * *

Mozart — The Last Six Symphonies. No. 35 in D Major ("Haffner"); No. 36 in C Major ("Linz"); No. 38 in D Major ("Prague"); No. 39 in E Flat Major; No. 40 in G Minor; and No. 41 in C Major ("Jupiter"). Columbia Symphony Orchestra conducted by Bruno Walter. Three 12-inch discs. CBS Stereo S3BR220013.

These excellent performances are issued in a boxed set at the reduced price of £7/7/ which should make them attractive to those who will not be duplicating performances they already have. Others starting to build a record library should find them particularly tempting. And while you may know of, or own, a performance of one of the symphonies that perhaps you prefer under other direction, Walter's readings are so full of love and reverence for the music that I doubt if you could find a more beguiling version of all six.

Not surprisingly you may, in some movements, miss the liveliness of Beecham, in others the solidity of Klemperer, and again strong personal characteristics of the many conductors who

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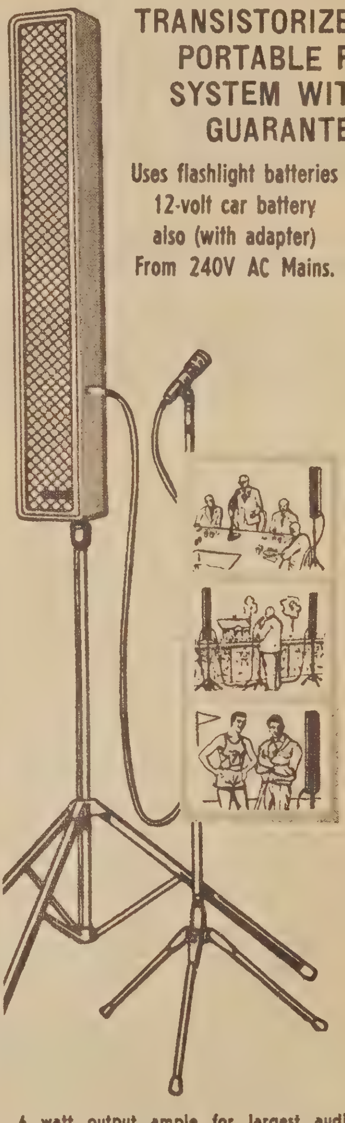

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ve recorded them from time to time. it, for my book, none rivals Walter the deep sense of security and im- aculate styling that he brings to these rformances.

Walter's tempos are not of the tick- ck kind often favoured nowadays, but the other hand his variations are ver freakish or unstable. He lets the usic flow first here, then there, in the ost natural way imaginable. Some teners might prefer broader handling the last three "big" symphonies, a der dynamic range, a stronger drive. nd these they can find elsewhere. Per- nally, I retain an abiding affection for alter's readings as you hear them here, spite more forceful versions by other nductors.

The Columbia Symphony Orchestra ays sensitively and generously for the nductor and, a rare spot of pre-echo art, the engineering is admirable. A ort but informative booklet accompan- the set.

* * *

Handel — Organ Concertos. Op. 4. o. 1 in G Minor; No. 2 in B Flat ajor; No. 3 in G Minor; and No. 4 in Major. Marie-Claire Alain (organ), th the Jean-Francois Paillard Chamber rchestra conducted by Paillard. Record ciety Stereo No. 6100.

This disc has one very great merit. should be invaluable to those who ncern themselves with the baroque yle, especially in the matter of orna- entation. For Madame Alain never erdoes the gracing and her extempori- tions of missing sections of the solo rt are exemplary. The organ she uses ccording to the sleeve notes it is the e in the Maronites Church in Paris) sweet-toned, as a baroque instrument ould be, but never cloying.

It always sounds, even when fully ex- nded, in amiable balance with the nall string orchestra, which is ably con- icted by its founder. It is also encour- ing to notice that this disc is an- ounced as Volume 1, which makes it ppear likely that the complete set of ncertos is to be issued by the Record ciety in the future. Should that be so, hope the producers, the Erato French mpany, pay more attention to the ality of the engineering. In this disc ere are some annoying intrusions of pe hum and an orchestral bass that t even a hefty boost will bring into ue focus with the rest of the ensemble.

However, on the basis of its stylistic rity and the musicianship of the play- s it still carries a strong recommenda- on from me.

* * *

ISZT — Piano Concerto No. 1 in E Flat Major. Piano Concerto No. 2 in A Major. Julius Katchen with the London Symphony Orchestra conducted by Ataulfo Argenta. Ace of Diamonds Stereo SDDA124.

Ace of Diamonds is a recently issued ecco economy priced label (36/6) that fers buyers new pressings of titles put it some six or seven years ago. This eans that they are more recently re- rded than the majority of the now mous Ace of Clubs series from the me company, the price of which has een reduced to 29/6. I have osen what I thought the best from e first two issues with the hope of eing able to get around to noticing the lance next month.

I consider this record of the two Liszt ncertos a great bargain. It offers soloist, conductor and orchestra in fine form. Although Katchen has lately been recording a more serious type of piano music — his complete Brahms, for instance — and disclosing thoughtful and convincing artistry in the process, he plays bravura works like these two concertos with an elan that challenges the best his competitors can produce.

His soft, fast runs have the pearly lustre of a fine Chopin player's; his hammered fortissimos plenty of power without harshness. Yet though his are essentially virtuoso performances, they are always disciplined by the best of musical taste. Ataulfo and the London Symphony Orchestra supply just the right type of accompaniment, sympathetic in the quiet passages but with plenty of assertion in their own, more showy bits. The sound, too, is very good, clear, full, and rich with orchestra and soloist always in satisfactory balance.

* * *

Mozart — Piano Concerto No. 27 in B Flat Major (K.595). Sonata No. 11 in A Major (K.331). Wilhelm Backhaus with the Vienna Philharmonic Orchestra conducted by Karl Bohm. Ace of Diamonds Stereo SDDA116.

This disc, too, is notable for the good balance between piano and orchestra and clean, virile sound kept always within the dynamic range of 18-century style. The presentation of the concerto by both soloist and conductor is purely classical, but without austerity — if the slow movement is perhaps excepted on the grounds of slight coolness, though there will be many who welcome this type of reading. I know of no comparable account of the concerto offering at anything like the price.

There is much to recommend also in the fill — the A Major Sonata, played without stenographic mannerisms and again stylistically pure. In case you might have forgotten, this is the sonata that uses the "Alla Turca" tune in the Finale.

* * *

Mendelssohn — Symphony No. 4 in A Major, Op. 90 ("Italian"). Schubert —Symphony No. 5 in B Flat Major. Israel Philharmonic Orchestra conducted by Georg Solti. Ace of Diamonds Stereo SDDA121.

The Mendelssohn receives a quite wonderful performance by Solti and the Israel Philharmonic. The first movement, taken at a very lively pace, is sunny without glare. When its speed is considered, the players display extraordinary refinement of nuance and dexterity of articulation. The final Salterello, too, goes very fast indeed. In fact I cannot recall ever having heard it go at this bat while preserving accuracy and elegance.

The third movement might have benefited from more amiable, less hard-driven treatment but this is a point on which other listeners may not agree. Altogether this is as exhilarating a performance as you'll find anywhere, on any label, today.

I am sorry I cannot say as much for the Schubert, a gem among symphonies, which Solti sounds a little impatient to get through. Had he indulged the music just a trifle more, the result would have been so much more satisfactory. But even here the playing is quite acceptable, and to my mind the Mendelssohn alone is well worth the price asked for the whole disc. ∎

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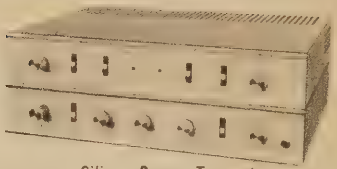

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OCUMENTARY RECORDS

Reviewed by Ellis Blain

YME AND RHYTHM, with Michael Hordern, Spike Milligan, Patrick Wymark and others—Argo RG 414.

This is the first of four records de- ed for the education and entertain- t of children. The records, graded age, are accompanied by a hard cov- book which contains all the texts ether with some most useful edi- al information.

ecord one is designed primarily seven-year-olds but I can vouch for fact that it is quite suitable for four- -olds, especially if they have a pre- osition to music, as the content is ely music.

he essential aspect is that here is contemporary approach to education entertainment. No one should have ersuade a normal child to listen to . The problem may well be found reverse . . . From every aspect I only endorse the rave reviews of rseas colleagues who have acclaimed series without reservation as the best erial for children yet put on record.

verything about it has been done authority, knowledge and, above all, understanding of the child's in- sts and attitudes. The performers e been chosen with a care that is ost inspired and the choice of erial is very wide indeed, including or two items by Tasmanian author, e Sansom, and "an Australian song" ed "The Kangaroo," of which I have heard.

ecording, performance and produc- are of the highest quality and a cial mention should be made of the et which is contemporary, eye-catch- and appealing. It matches the ac- npanying book, which is published by cmillan and available from record es handling the discs.

n short, I have seldom received for iew a record which I can recommend such unequivocal enthusiasm.

* * *

DEN NASH READS OGDEN NASH—Caedman TC 1015.

an there be anyone who can read whom Ogden Nash is unknown? But ause he has been unique and, conse- ntly pre-eminent in his field for so g, one is inclined to think of him as it dated. In fact, he is nothing of kind and most of the pieces here orded will come fresh as Ogden Nash all.

hat is the essence of his material? is zany, nonsensical, meandering, fy, but somehow never fails to leave with an attitude—almost invariably timulating, new attitude and a sense well-being to go with it. It has been that Nash is America's best pro- tion from America. This I believe. haps he might also be man's best tection from man and, as such, an inently desirable quality in every me.

hould you agree with this view, I uld enthusiastically recommend this comprehensive collection of his work, read with Bostonian propriety by the author himself.

* * *

BERTRAND RUSSELL—Produced and edited by John Chandos. Pye PLP 1095.

These recordings were made in Earl Russell's home in North Wales in April, 1961. Before offering criticism of the production and technical aspects, I must acknowledge the fascinated interest with which I listened to both sides of this extraordinary disc. The discussions were quite informal and conducted over two days, the subjects range wide and far and include nuclear disarmament, Christianity, morality, international affairs, original thinking and persecution and portraits of Lawrence, Shaw, Lenin, Einstein and Conrad.

The treatment is always most personal and gains greatly from this fact. To have any advantage over the written word, the spoken word must be personally expressed and, preferably, informally, too . . . Bertrand Russell has a remarkable gift for expressing profound thoughts so lucidly that even the more slovenly minded of us can follow each progression in the argument. In addition, he seems to me to go a good deal further on most of his subjects here than I have heard him do in his many broadcast talks. If I am right, doubtless the reason is that the recording was made in his own home.

And this brings me to the faults referred to briefly above . . . In the first place, the recorded sound is full of what sounds to me like very crude distortion — possibly overload — and a resultant lack of presence, particularly when Russell is speaking. One does not miss a word but it is an effort to give one's full attention continuously. The questioner seems to have been dubbed in sometimes and when this is the case, the sound is quite clear. The other fault is the crude editing. No broadcasting organisation would have passed such emasculation and obvious lack of elementary continuity. In fact, I should think most talented amateurs would have done much better.

Having said that, I can only commend the record to you as some of the most absorbing spoken word material so far to be made available to the public.

* * *

THE SWORD IN THE STONE, by T. H. White—Argo EAF 63.

This little forty-five is no more than an excerpt from a delightful fantasy for older children which has superficial connection with the story of King Arthur and his knights.

It is read by the author and the fascinating incidental music which accompanies it was composed by Benjamin Britten for the original B.B.C. Children's Hour production. ◘

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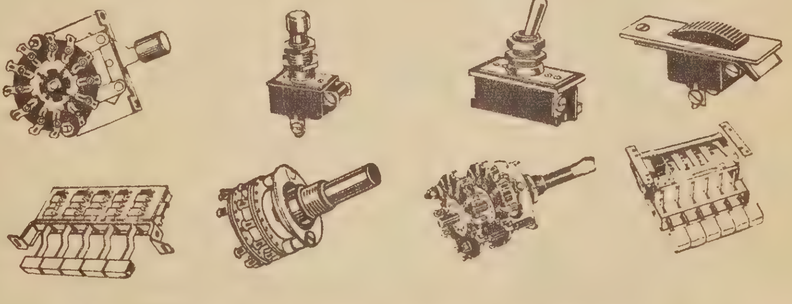

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VARIETY FARE

"ELECTRONICS Australia"
Staff Review
Panel

)evotional

HE VALLEY IN SONG (Sung in Welsh). The Morriston Orpheus Choir, conducted by Eurfryn John A.R.C.O. Accompanist Miss Jennie Sims L.R.A.M. Stereo, Columbia SCXO-3552. Also available in mono 330SX-1724.

Interest: Welsh choir.
Performance: Magnificent.
Quality: Good.
Stereo: Excellent spread.

About the only two words I under-ood in this whole disc were "Barrabas" id "Hosanna." But with magnificent nging like this, words don't seem to iatter.

Recorded quite recently at the Taber-acle Chapel, Morriston, Swansea, South /ales, the all-male choir is at times iassive in its recitation and praise, at mes subdued and tender but always in erfect accord with the conductor. Bari-one soloist Edward Plucknett is out-anding, as also is Miss Jennie Sims at ie tabernacle organ.

On side 1 is "Arglwydd Da, Nid /yf Deilwng" (Domine, non sum dig-us)—De Victoria; and the complete Iesu Of Nazareth"—Dr Parry.

On side 2: "Sanctaidd Ior" (Holy ord)—B. Treharne; "Matona, Fy An-ylyd" (Matona mia cara)—Di Lasso; Tydi A Roddaist" (Thou Gavest)—T. R. lughes; "Cytgan Y Pererinion" (The ilgrims' Chorus)—Dr Parry.

For any one at all interested in choral iusic—highly commended. (W.N.W.)

* * *

IYMNS WE LOVE. The Mills Brothers. Mono, Dot (Festival) ZL-31,736.

Interest: Gospel songs.
Performance: Spontaneous.
Quality: Excellent.

Most American singers and groups eem to have had their start in the little ocal church; it is natural, therefore, that iey should crown their success in other elds with an album of the hymns that iey always treasured!

Whether or not my cynicism is justi-ed, the Mills Brothers sing these hymns s if they really enjoy doing so. In fact, ith their excellent harmony and dic-on, they are quite a pleasure to listen . The only jarring note is the organ ccompaniment, which is probably in-ended to simulate the chapel harmonium ut which succeeds only in sounding like Hammond electric played in the most iechanical fashion imaginable. Fortun-ely, its intrusion is confined largely to ie start and finish of each track; else-here, it is dominated by the excellent ocal.

"Just A Closer Walk," "Nearer My iod To Thee," "In The Garden," "Sweet lour Of Prayer," "Rock Of Ages," "Bringing In The Sheaves," "Brighten The Corner Where You Are," "In The Sweet Bye And Bye," "Jesus Wants Me For A Sunbeam," "Were You There," "Holy, Holy, Holy," "The Old Rugged Cross."

Well worth a hearing. (W.N.W.)

* * *

THANKS BE TO GOD. Paul Mickelson conducting the Cathedral Symphony and Choir Of London. Stereo, Supreme SS-2011 (Southwell Supplies, 176 Geelong Road, Footscray, W11 Vic.). Also available in mono.

Interest: Thanksgiving themes.
Performance: Very good.
Quality: Good.
Stereo: Normal spread.

One of the features of American church life is the traditional observance of thanksgiving, which dates back, according to the jacket notes, to the early settlers in New England.

These are all thanksgiving themes, intended for the U.S. record market but certainly not exclusive thereto. The unaccompanied choir sings "Thanks Be To God," "Pilgrim's Chorus" and "Now Thank We All Our God." And an excellent performance it is.

The Cathedral Symphony Orchestra presents "Fantasia On The Alleluia Hymn," a praise hymn with which most worshippers will be familiar and "Now Thank We All Our God," in which the theme is proclaimed by the full orchestra.

Orchestra and choir combine in fine fashion for "The Old Hundredth," "We Praise Thee Oh God Our Redeemer" and the final item "A Song Of Thanksgiving," featuring the voice of Helene Landrum.

Falling somewhere between simple Gospel music and the formal religious classics, this album should have quite wide appeal which will be augmented, for most listeners, by the varied use of choir and orchestra. Commendable. (W.N.W.)

* * *

GLORY FILLED MY SOUL. Artists of the Christian Youth Camps. CYC-12-02.

Interest: Youth devotional-cum-entertainment.
Performance: Gifted amateur artists.
Quality: Good.

The artists represented on this album are a gifted and devoted group, who give their support to youth camps, rallies and evangelical activities, mainly in the Sydney and near-country areas. Like their first disc "Beyond Tomorrow" (Reviewed Feb. 65) the numbers on this disc are closely related to what the group presents on platform. Technically and musically, they are of a standard which should ensure their ready acceptance by all with an interest in the C.Y.C. organisation or in the artists as individuals.

I imagine, however, that the group is aiming its records at the widest possible audience and, with this in mind, I would make three comments for their

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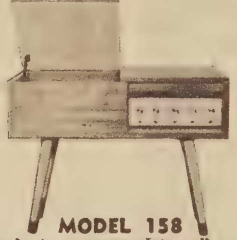

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COLIN JOHNSON

"LOVE LETTERS"

3AW Broadcasting Co. Pty. Ltd.,
382 Latrobe Street,
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December 1, 1965

Dear Sirs,

I feel I must write to you to express my profound delight at the superb performance of the ADC-660/E pickup cartridge and the J. H. Synchronous Turntable.

I have now been using this turntable for ten months and have been really startled by the complete absence of rumble, wow and flutter which, I also find, manifests itself in a much cleaner and "tighter" bass response. I am only sorry that I did not know of the existence of this fine unit when I bought another costing almost twice the price and yet not offering anywhere near the same performance.

For the ADC-660/E cartridge I also have nothing but praise. The most apparent feature of this superb head (as compared with other brands I listened to most critically) is an extremely musical sound quality, which makes one feel completely relaxed. Definition, clarity and particularly cleanness on hitherto strident brass and soprano passages is amazing. All this, too, at only a pressure of a little more than 1½ grams as compared with my former playback head, which required more than two grams. I have not yet heard the ADC Point Four/E or the new ADC-10/E, but I understand they are better still.

Finally, a small but important point. The stylus assembly can be changed by the user with ease and absolute safety in a few minutes.

Yours faithfully,

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Executive,
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ıre consideration.

1) Instrumental ensembles would ıefit from more variation or arrangent.

2) Some vocals tend toward the chanical.

3) Accompaniments, excellent in mselves, are recorded generally at too h a level.

All of these things stem, I think, from essing a presentation on the basis of platform appeal and balance, intead on a detached "sound-only" basis.

However, I must stress that these resent very much "second order" icisms and you should find plenty to oy in this album:

"When His Glory Paints The Sky," ord Keep Your Mighty Hand On Me," eaven Came Down And Glory Filled Soul," "Ye Must Be Born Again," s Your Life," "Wonderful, Marvels, Yet True," "My Last Move," here's Not A Day That Passes," "Why rry When You Can Pray," "My her Planned It All," "Above All e," "I Want To See My Saviour First All," "In A Little While," "There's Excuse," "The Glory Road To aven."

Recorded at the Voice Of Melody dios. the quality, technically, is excelt. (Available from The Voice Of lody, 25 Ray Road, Epping, N.S.W., yrymple's stores, and most C.Y.C. nps in capital cities.) (W.N.W.)

★ ★ ★

Y IS DYING IN THE WEST. Paul Mickelson at the NBC Pipe Organ. Stereo, Supreme Console CS-6001. Also available in mono CM-5001. (Southwell Supplies, 176 Footscray Rd, Footscray W.11, Vic.)

Interest: Pensive pipe organ melodies.
Performance: Restrained but capable.
Quality: Normal
Stereo: Not especially significant.

The title "Day Is Dying In The West" ly describes the mood of this disc. the titles have to do with sunset, light and evening and the sound lf is pensive and subdued. If the idea such a disc appeals, you'll probably oy playing it quite a deal, either for sonal listening or as a prologue to gious gatherings.

But if, on the other hand, you're look- for an organ disc with a bit of angelical fire and fervour, this isn't it. t that Paul Mickelson can't play an gan that way, of course; it's just that has chosen not to do so on this asion.

The titles: "Day Is Dying In The st," "Softly Now The Light Of Day," t The End Of The Road," "Over The nset Mountains," "The Lights Of me," "No Night There," "Good Night d Good Morning," "Just A Song At ilight," "The Evening Star," "Moonıt Sonata," "When Day Is Done."

An imported American pressing, it is hnically well up to standard, although modest nature of the sound makes no cial demands either of frequency reonse or dynamic range. The only thing t had me wincing (as usual) was the ınd of the chimes, which not only ınd off key themselves but create an pression of the organ itself being in poor state of tuning. A slight swing the tracks tends to compound this ct, though it is only likely to be iced by those with a critical ear for ch. (W.N.W.)

Instrumental, Vocal & Humour

JOHANN STRAUSS PROMENADE. The Vienna Concert Orchestra, conducted by Max Schonherr. Festival, Stereo SFL-931,757, (also available in mono FL-31,757).

Interest: Familiar and unfamiliar Strauss.
Performance: Satisfying.
Quality: Good, but . . .
Stereo: Nice, even spread.

Yet another Strauss recording, this time with some of the lesser known works mingled with some of the best known. The disc has 12 numbers, and some of the longer waltzes have perforce been considerably shortened. (The original "Blue Danube" score can take as long as 12 minutes to play, but the short version here takes less than four minutes). The Vienna Concert Orchestra plays with great verve, from what I imagine is Strauss's original scoring, and one has the impression that this is how Strauss intended his music to sound. What a welcome relief this is from the "arrangements" so often perpetrated by some lesser conductors, who presumably believe their versions are better than the originals.

With all the good points this disc has to offer, it is a pity that the sound is not all that could be desired. The recording studio where the performances were recorded seems to have a completely dead accoustical characteristic, with the result that the sound has a rather flat quality which lacks "presence." Despite this, the disc should have great appeal to Strauss fans, and is worth a trial.

"Vienna Bon Bons," "Perpetual Motion," "Tales of the Vienna Woods," "Pizzicato Polka," "Wine, Women and Song," "Egyptian March," "Vernugungszug Polka," "Emperor Waltz," "Fire Festival Polka," "Blue Danube," "Vienna Blood," "Tritsch Tratsch Polka."

(H.A.T.).

★ ★ ★

THE NEW SOUND OF BROADWAY. The Melachrino Strings And Orchestra. Stereo Dynagroove, RCA-LSP-3323. (Also available in mono).

Interest: Broadway melodies.
Performance: Bright and gay.
Quality: Very clean, well balanced.
Stereo: Excellent spread.

The "Hello Dolly" theme which opens this album is probably the best known of Jerry Herman's songs but, as the jacket notes point out, this young composer and lyricist (still in his early thirties) has studded his writings wth many memorable songs like those which characterise his popular "Milk and Honey" and the even more popular "Hello Dolly."

And I think it fair to comment that the Melachrino strings and orchestra have done them full justice in this album, which is bright, gay and highly listenable from the first note to the last.

And if you don't know some of the songs as well as others, it doesn't matter at all: "Hello Dolly," "It Only Takes

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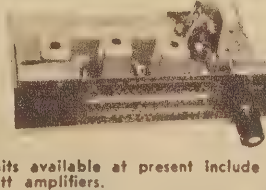

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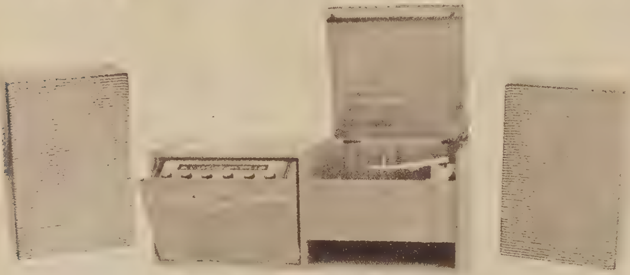

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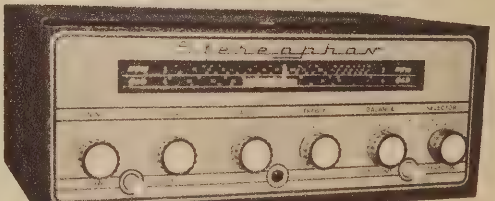

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★ ★ ★

MES BOND — 007. Movie themes, including "From Russia With Love," composed and conducted by John Barry. Festival 12-inch stereo, SFL-931,768. Also in mono on FL-31, 768.

Interest: Movie themes.
Performance: Smooth, expansive.
Recording: Very good.
Stereo Quality: Smoothly spread.

Another disc of movie themes featur- g the composer as conductor, this time aturing "James Bond Music Ltd.," John rry. In presenting Mr Barry's music provides both entertainment and in- ht into the characteristics of success- l movie music.

The tracks are labelled "From Russia ith Love," "007," "The Elizabeth ieme," "The Loneliness of Autumn," liki," "Fancy Dance," "Kinky," "Ngen- ni," "Tetha Leyanto," "Monkey Fea- ers" and "Big Shield." The playing is sciplined and smooth, and is amply dowed with the appropriate expansive- ss. The recording is fine.

For Bond addicts, mainly, and to these commended. (J.R.).

★ ★ ★

ARCISO YEPES—Spanish Classical Guitar Music. Pieces by Villa-Lobos, Tarrega, Malats, Albeniz, De Falla and Isaias Savio. London-Globe 12-inch mono, H.A.A. 7758.

Interest: Classic guitar.
Performance: Masterly.
Recording: Very good.

A disc featuring the talented guitarist rciso Yepes playing small works by s compatriots, and revealing not only e ever-surprising capabilities of the itar but also Senor Yepes' very con- lerable mastery of it. It makes most scinating and satisfying listening.

The pieces played are "Preludio umero 1" by Villa-Lobos, "Recuerdos la Alhambra," "Capricho Arabe" and ran Jota" by Francisco Tarrega, erenata Espanola" by Joaquin Malats, umores de la Caleta" and "Asturias" Isaac Albeniz, "Danza del Molinero" Manuel De Falla, and "Escena Brasi- nas" by Isaias Savio.

The recording is of very good quality, th very low surface noise and dis- tion. (J.R.)

★ ★ ★

ANCE TO THE TOP POPS with Joe Loss and his Orchestra. Stereo, HMV OCSD-1579. (Also available in mono OCLP-1819.)

Interest: Strict dance tempo.
Performance: Average.
Quality: Average.
Stereo: Average again.

As distinct from the majority of rict tempo discs, this latest offering om Joe Loss and his British dance nd is best described as "busy." The mark is particularly true of side 2, of hich about three-quarters is devoted to hake." It's certainly for dancing but nply won't be relegated to any kind background role.

All tracks are medleys ranging in ope from "Ramona" to "A Hard ay's Night." On side 1 is a quickstep medley, a foxtrot, a Latin American and a waltz medley. Side 2 is mostly shake, with one foxtrot medley interposed. The title is accurate in this case: "Dance to the top pops . . ." (W.N.W.)

★ ★ ★

STEPPING LIGHTLY INTO SCHOOL. The Waratah Festival Brass Ensemble Conducted and arranged by Raymond Cray. Mono, Festival FL-31,793.

Interest: As per the title.
Performance: Routine.
Quality: Normal.

Raymond Cray, with extensive experience as a solo trumpeter, arranger and conductor in the theatrical and club world, has applied his talents in adapting a variety of typically Australian tunes to the role of school marches. And I must admit that, in my younger days, something like his version of "Tie Me Kangaroo Down Sport" would have been a welcome change from those very much over-played British military marches.

The Waratah Festival Brass Ensemble is a group born out of the Sydney's annual Waratah Festival, the players being named on the jacket.

The pity is that the end result doesn't sound better than it does — at least to my ears. Being in strict march tempo, it should be quite okay for marching, as per the title but, musically, the performance leaves a lot to be desired.

The titles: "Click Go The Shears," "Wild Colonial Boy," "Yarrawonga," "Advance Australia Fair," "On Parade," "Gundagai," "Victory V" "Waltzing Matilda," "Tie Me Kangaroo Down Sport," "Waratah March," "Carnival." Just so-so. (W.N.W.)

★ ★ ★

MAGNIFICENT MOVIE THEMES. Enoch Light and The Light Brigade. Master recording on 35mm magnetic film Command 12-inch stereo, SNDL 931,765. Also in mono on NDL 31,765.

Interest: "Big" movie themes.
Performance: Bright and expansive.
Recording: Excellent.
Stereo Quality: Well spread.

Another collection of movie themes from Enoch Light and his Light Brigade, featuring Doc Severinsen on trumpet, Dick Hyman on harpsichord, Tony Mottola on guitar and Robert Maxwell on harp. They swing brightly and with typical Light expansiveness through the themes from "Zorba The Greek," "Ship of Fools," "The Yellow Rolls-Royce," "Dear Heart," "Mary Poppins," "Fanny Hill," "Goldfinger," "The Third Day," "Von Ryan's Express," "The Amorous Adventures of Moll Flanders," "The Sound of Music" and "The Sandpiper."

The recording is of typical 35mm Command quality — excellent. What more need I say? (J.R.).

★ ★ ★

THE BEST OF CARMEN CAVALLARO, The poet of the piano. Two-record set in box. Stereo, Festival SDL-931,654, SDL-931-655.

Interest: Popular piano, plus.
Performance: Nimble.
Quality: Good.
Stereo: Normal.

Carmen Cavallaro is a very nimble-fingered keyboard entertainer who can weave a delicate pattern of melody from solo piano, pace it with a rhythm group or front up to a full orchestra with his

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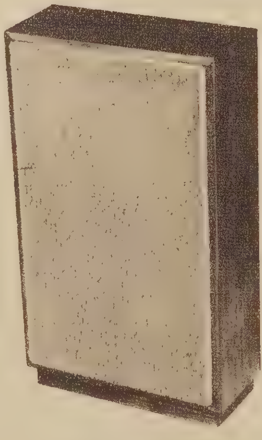

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this two-record album, amply demo
strating his capacity and versatility as
keyboard entertainer. It's just a questi
of whether or not you like this sort
thing but, if you do, you'll certainly sp
these discs quite a few times.

Record 1 contains: "Chopin's Polo
aise," "Manhattan," "I've Got My Lo
To Keep Me Warm," "Dolores M
Own," "Brazil," "Hungarian Rhapso
No. 2," "Deep Night," "The Secon
Time Around," "Charade," "Frenesi
"In Love," "The Lady Is A Tramp

On record 2: "Non Dimentica
"Everybody Loves A Lover," "The
Can't Take That Away From Me
"Warsaw Concerto," "Moon River," "E
lloro," "Dancing In The Dark," "Obse
sion," "Padam-Padam," "Carnival C
Venice," "Fascination," "Hanayone-Ni
gyo." (W.N.W.)

* * *

**DANCE TO THE TANGO. TH
CASTILLIANS. Orchestra conduc
ed by Lucio Mileno. Recorded i
Argentina. Stereo, Festival SD
931,772. (Also available in mon
DL-31,772).**

Interest: Authentic Latin-America
Performance: Tops.
Quality: Excellent indeed.
Stereo: Excellent spread, definitio

Lucio Mileno, Italian by birth, an
with a Master's degree in musical com
position, has pursued his career, for th
most part, in Argentina. As a recordin
artist, he has sold millions of record
mainly in South America and Europ
this one reaching us through Festival
arrangement with American Decca.

From an experienced musician lik
Mileno playing South America
music with a South American orchestr
one has a right to expect something goo
—and good it is.

The music is vital, the rhythm
sharp, the arrangements are good an
the playing is first rate. On the tw
sides you get: "A Media Luz," "L
Cumparsita," "Don Juan," "Uno," "Blu
Tango," "Adios Pampa Mis," "E
Choclo," "Caminito," "Celos (Jal
usie)" "Adios Muchachos", "Canaro E
Paris," "Una Lagrima Tuya."

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the sound right out of the top draw
— clean, full and with excellent ster
definition.

A good one. (W.N.W.)

* * *

**BOBBY LIMB'S CENTENARY T
SHOW. From the 100th pe
formance of Bobby Limb
"Sound Of Music". With orchest
directed by Bob Gibson, produc
by Frank Marcy. Mono, Festiv
FL-31,796.**

Interest: Popular TV show.
Performance: Good.
Quality: Normal.

Bobby Limb's popular TV sho
"Sound Of Music" needs little intr
duction to the Australian audience, n
do the artists featured on this recordin
Bobby Limb, Rosalind Keene, Bill Ne
man, Darryl Stewart, Frank War
Shirley Sunners, Betty Parker, No
Lester and Margaret Day.

Assembled from the sound track
the centenary show, the album presen
music for everybody: Introduction an
"Happy Birthday To Us," "A Spoo
full of Sugar," "Love Is A Man
Splendoured Thing," "Swinging On
Star," "I Love Life," "20's Medley,
"Waiting At The Church," "Macushla

Keys Of Heaven," "Speak To Me Of ly Mother," and "Lola Montez Medley inale".

In some of the tracks, the artists annot escape direct comparison with e big-name stars with which the titles ave come to be associated but, gene-ally, the Bobby Limb group acquits self very acceptably, a special note f commendation being warranted for ob Gibson's orchestra.

Followers of the television show hould especially welcome this album, ough this is not a necessary quali-cation for its enjoyment. (W.N.W.)

★ ★ ★

OHN ROBERTSON and his Multi-Trumpets, with Orchestra under the direction of Thomas Tycho. RCA, Stereo. SL101,651. (Also available in mono.)

Interest: Australian trumpet virtuoso.
Performance: First class.
Quality: Fairly good.
Stereo: Even spread.

Those who admired the playing of ohn Robertson on his three previous P discs will be just as pleased and de-ghted with this, his first "full blown" P album. It is, musically, right up to e standard of his previous efforts and atures John in his now famous one-an-trumpet-section role.

The tempos are mostly samba, bossa-ova, cha cha and rumba, all lightly nd politely handled by the orchestra nder the direction of Thomas Tycho. he latter, by the way, deserves a special ound of applause for the excellent ar-ngements he has created for the disc.

"Valencia," "Sugar Plum Cha Cha," Wish You Love," "Reginella Cam-agnola," "Say Si Si," "Andalucia," Granada," "The Girl From Ipanema," Chicken Talk," "Carnival," "La pagnola," "Patricia."

The audio quality is not the best I ave heard — multiple dubbing techni-ues seems to increase the background oise and result in a sound which is, at mes, a little less than absolutely clean - but this will only be apparent on the ery best of equipment. The stereo ef-ct is nicely handled and has a good, ven spread. (K.W.J.)

★ ★ ★

WIN TRUMPETS DISCOTHEQUE A GO-GO. Doc Severinsen with his trumpets and orchestra. Command, Stereo. SNDL-931,766.

Interest: Trumpet virtuoso.
Performance: Great.
Quality: First class.
Stereo: "Over dubbed" (see text).

This new disc is a multiple recording which Doc Severinsen plays two umpets, one from each stereo channel, gainst a background of the captivating ew rhythms that are tending to domin-e contemporary popular music. The sult is quite an exciting "new sound."

Doc Severinson has an amazing tech-ique and lustrous trumpet tone, which heard to full advantage in this disc. n his two-trumpet "over dubbing" he ometimes has both instruments playing virtuoso role with the lead switching om one instrument (and channel) to nother and at other times is content play close harmony with himself in sound closely resembling the Tijuana rass of Herb Alpert. Whatever the rangement, the appearance of the two umpets comes about smoothly and aturally.

"It Ain't Necessarily So," "Hey, Pretty Pussycat," "I Will Wait For You," "Bluesette," "Memories Of You," "Malaguena," "What's New," "What's Up Doc?" "Manha De Carnavel," "The Phantom Trumpet," "For Mamma," "If I Had A Hammer," "You Are My Sunshine."

The audio quality is first class and in the very best "Command" tradition and the stereo has normal separation of the orchestra with the two trumpets completely separated to individual channels (K.W.J.)

★ ★ ★

SONGS WE LOVE. The Glasgow Phoenix Choir. World Record Club, Stereo 7087.

Interest: Famous Scottish Choir.
Performance: Excellent throughout.
Quality: Very good.
Stereo: Normal spread.

Unaccompanied choral singing is something of an acquired taste but, for those who like choirs, this latest offering from the World Record Club

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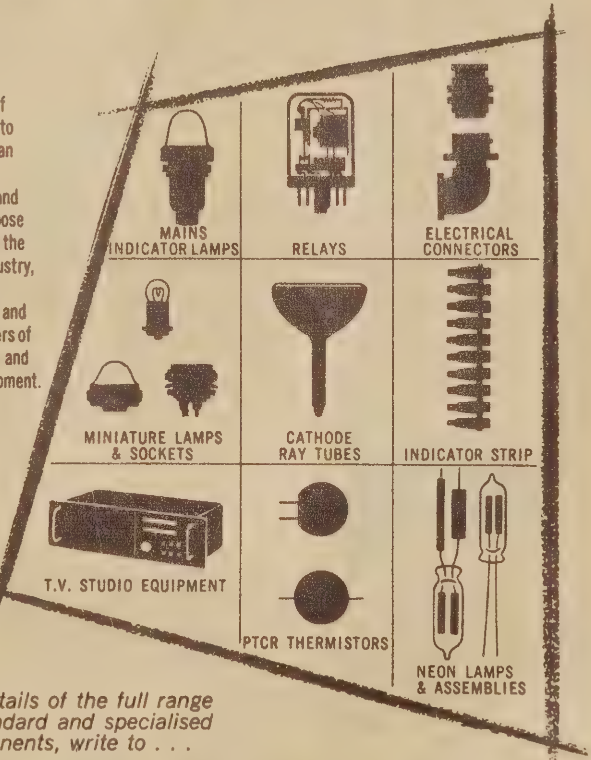

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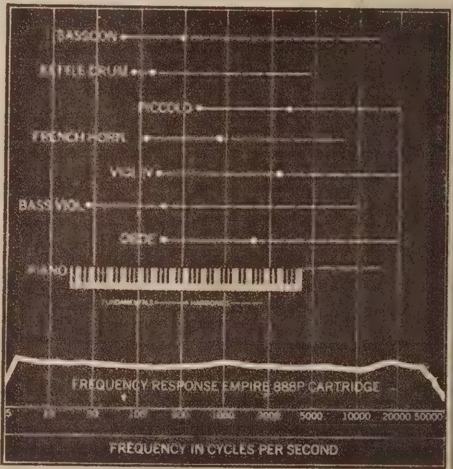

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one they will not want to miss. The lasgow Phoenix choir is a group which se from the ashes of the defunct lasgow Orpheus Choir, and has inerited the world-wide reputation estaished over 50 years of singing by the tter group.

Presumably the singers are all amaurs, who sing for the love of singing. t any rate, they sound that way, so at the measure of bored competence ten detectable in the renderings of ofessional groups is replaced here by air of unaffected enjoyment and love singing for its own sake.

Not surprisingly, most of the numbers this disc are arrangements of Scottish rs and folk tunes, and the choir sounds st in these. In all numbers except the st (the Bach chorale "Jesu, Joy of an's Desiring") they sing unaccompand, in straightforward four-part harony. A solo soprano voice takes the ads in a few places, with the choir nging wordlessly to deputise for orchera. A piano is brought in to provide e continuo in the Bach chorale (how uch better an organ would have sound). Technically, the disc is well up to e usual high World Record standard.

Some of the numbers presented will considered by some to be hackneyed it the Phoenix singers approach their sk with enthusiasm and somehow anage to instil a welcome degree of eshness into even such hoary chestits as "The Campbells are Comin'" id "The Hundred Pipers".

"Johnnie Cope", "Belmont," "Iona oat Song," "The Barrin' O' The Door," Dream Angus," "The Old Woman," 124th Psalm," "The Campbells Are omin'," "In Silent Night," "My Love welt In A Northern Land," "An riskay Love Lilt," "Far Away," "The undred Pipers," "Jesu, Joy Of Man's esiring." (H.A.T.)

* * *

TRANGERS AND COUSINS — Pete Seeger. Songs from his world tour. CBS 12-inch stereo, SBP 233242.

Interest: "Dedicated" folk music.
Performance: Moving.
Recording: Very good.
Stereo Quality: Irrelevant.

I have put the word "dedicated" above quotes to signify that it is not eing applied in the usual indiscriminate ashion; Pete Seeger strikes me as a comletely dedicated folk singer. And yet he n't one of these self-conscious and self-ghteous bleaters who despite half-baked ilosophies and microscopic musical lent claim importance because of their topian visions. With a modest and own-to-earth concept of himself, he ngs the songs of many countries not nly in order to help in promoting interational goodwill, but as he puts it "to eet my audiences halfway. If they are illing to listen to some of my down-ome music, at least I can make an ttempt to learn some of their own own-home music."

A dedicated performer, then, but the edication is no-nonsense and not to the xclusion of entertainment. This sort of edication we could use in larger quanties; it's less nauseating, and very kely more successful.

The disc under review is a collection f songs gathered by Seeger for his world our a couple of years ago. There are pretty" songs like "Oh, Had I a Golden hread" and "May There Always Be unshine," poignant songs like "Peat Bog oldiers" and "Stille Die Nacht," wry ongs like "Manura Manyah" and "Uh, Uh" and many others — not to forget the now well-established "If I Had A Hammer," written by Seeger and Lee Hays in 1949. They all make most entertaining and subtly moving listening.

The recording is of very high quality, with very low noise and distortion to distract attention. The stereo is similarly unobtrusive.

A delightful disc, it seems to me, and one which should have a very wide appeal; especially to no-nonsense folkie lovers. (J.R.).

* * *

SONGS FOR LATIN LOVERS. The Ray Charles Singers. Command, Stereo SNDL-931,785. (Also available in mono NDL-31,785).

Interest: Popular Latin Tunes.
Performance: Smooth and Restrained.
Quality: Good.
Stereo: Double grouping.

Ray Charles obviously believes that the tune is the thing, and the job of the singers is to deliver it smoothly and pleasantly without obtruding too much into the listener's awareness. In the same way, the orchestra is not allowed to intrude into the vocal line, and is only noticeable when it provides pleasant noises during the periods when the singers are silent.

In the stereo record, the singers are arranged into two groups, one on each channel, with the female voices balanced against the male voices. With speakers spread some distance apart the "Latin Lovers" sound as though they are calling to each other across the room—a rather strange aloofness.

The connection between the songs is that they were originally written with lyrics in one or other of the Romance languages (Spanish, Italian or Portuguese). In this disc they are all sung in English, the result being rather too sentimental for my taste.

Most of the numbers presented are very well known, however, and seem to

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DM14.

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Impedance 50Ω or 50KΩ, Frequency response 100-10,000 cps, Sensitivity 75 d.b., Dimensions 3⅜" x 1¼" Weight 9⅛ ozs.

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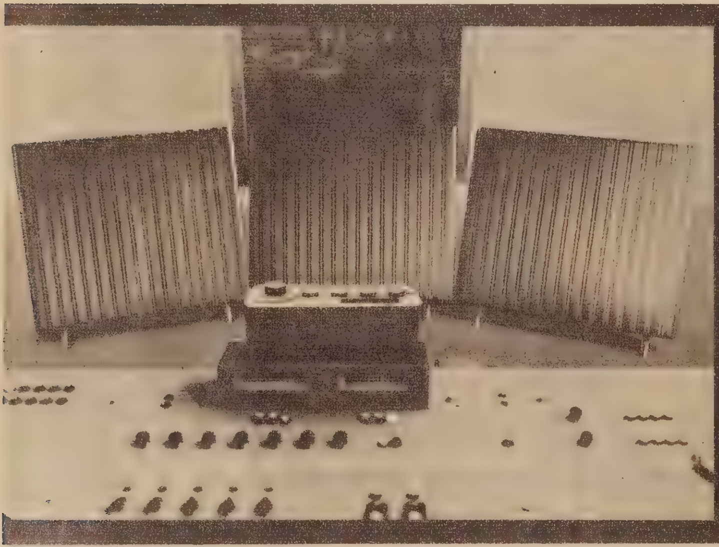

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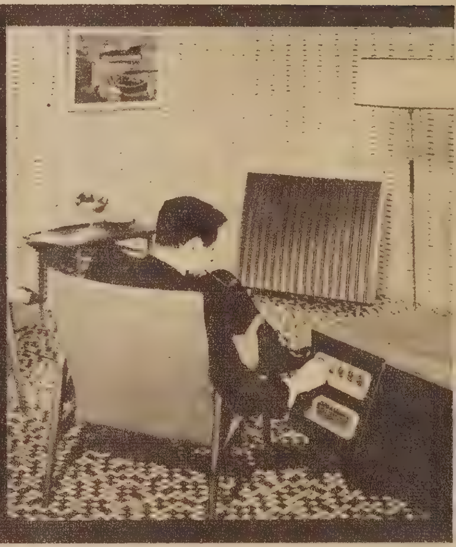

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of enduring popularity, some going ck over 25 years. Doubtless, they will ll be enjoyed when the current "teen at" and similar noises that pass for pular music today have been appro- iately interred. Technically, the disc is od, and it is recommended for back- ound or mood music.

The titles included are:

"Song of the Jet (Samba do Aviao)," ly Love Forgive Me (Amore, usami), "Marie Elena," "No More ues (Chega de Saudade)," "To You," dios," "Desafinado," "You're Mine (I cordi Della Sera)," "Amo, Amas, namus," "Carnival (Manha de Carna- l)," "My Guitar and My Song," "May od Be With You (Vaya Con Dios)." .A.T.)

★ ★ ★

NGS FROM TWO WORLD WARS. Hal Carter and Jack Speering. In strict barn dance tempo. Mono, Festival FI-31794.

Interest: Barn dance tempo.
Performance: For dancing only.
Quality: Normal.

The kindest things I can say about s disc are (1) that the songs emselves are undying, being firmly oted in the traditions of two world rs and (2) the tempo is strict. If you nt to dance, in nostalgic mood, you ght therefore be able to use s album.

But musically it has little to commend To my ear, the group sounds pretty ab and the whole effect is tediously chanical.

If it matters, the songs on the first e are from World War I, those on the cond from World War II. (W.N.W.)

★ ★ ★

LK CONCERT ON CAMPUS, recorded at The Union Theatre, Sydney University. R.C.A. 12 - inch mono, L101610.

Interest: Folk singing.
Performance: Excellent — world class.
Recording: Good.

Those who are inclined to think that al folk artistes are lacking in talent polish would do well to treat them- ves to a hearing of this recording de by R.C.A. during the concerts held the Sydney University Folk Music ciety in December 1964. It offers con- cing evidence that the best of the al artistes are quite up to overseas ndards. Quite apart from this it makes ghty enjoyable listening.

The singers heard are Beth Schurr, ging with her pure and tautly-con- lled soprano voice "The Keys of Can- bury" and "The Next Market Day"; sh Declan Affley, warmly singing ruiskeen Lan," "The Moonshiner," rian O'Lynn" and "God Bless gland"; Welsh tenor Roy Waterson, ging "Counting the Goats" and "Fair a" accompanied by Astrid Frost on Welsh harp; the versatile Jean Lewis ging "The Lag's Son," "Roberta" l "Emu Plains'; well known Paul rks with "Tom Pierce," "Sipping ler Through a Straw" and "The Frog l The Mouse"; and the very well- own Marian Henderson singing "Old Clark," "The Cat and the Mouse," e Devil and the Farmer's Wife" and uey Brink the Shearer."

While only a mono recording, the lity is extremely good, and the in- sion of the compere's introduction to h artist helps ensure the preservation the "live" atmosphere.

A most enjoyable disc, and one which can be recommended warmly to all folk music enthusiasts. (J. R.)

★ ★ ★

THE BEST OF BING CROSBY. Two-Record Set in Box. Stereo, Festival SDL-931,652 and SDL-931,653.

Interest: Bing.
Performance: Yes, Bing at his best.
Quality: Normal.
Stereo: Dubious.

There aren't too many singers to whom one can listen through four LP sides — and be rather sorry when they're finished. But that's the way I found it with this two-record album. As track follows track, one mentally registers "ah yes, that one of course," leading to the general impression that the Crosby "evergreens" are all there. They aren't, of course, as reference to other albums will readily establish but it's a pretty good selection to back up the title "The Best of Bing Crosby."

Perhaps I should list the titles, even if somewhat abbreviated: "Blue Of The Night," "Swinging On A Star," "June in January," "My Sunshine," "A Long, Long Time," "MacNamara's Band," "The One Rose," "Sweet Leilani," "An Old Cowhand," "Easy To Remember", "Pennies From Heaven," "Don't Fence Me In," "Sunshine Cake," "I Can't Begin To Tell You," "Mexicali Rose", "Wiffenpoof Song," "Play A Simple Melody", "White Christmas," "Dear Hearts And Gentle People", "Galway Bay", "Cool, Cool, Cool of The Evening," "Too-ra-loo-ra-loo-ra." "Sam's Song," "Now Is The Hour."

Taken from a variety of sources and with a variety of orchestral and choral backing, the sound could have been pretty patchy. American Decca have done a good job, however, in keeping everything fairly smooth and uniform. The "stereo" labelling is rather euphemistic, however, most of the tracks being a frequency-split version of the original mono recordings. This doesn't matter much, however, for a solo voice.

An album I can recommend. (W.N.W.)

POPULAR JAZZ

LULLABIES OF BIRDLAND featuring ELLA FITZGERALD, with the Ray Charles Singers. Universal Record Club, Mono. UJ700.

Interest: Jazz vocal.
Performance: Typical Ella.
Quality: Good.

This disc, originally released on the Decca label, features a variety of the styles and numbers which have distinguished Ella Fitzgerald's career. Included are latter-day versions of "How High The Moon" and "Oh Lady Be Good," the numbers which began Ella's post-war career and, I believe, were the first ever to use the human voice as solo instrument in jazz ensemble work.

These numbers plus others such as "Basin Street Blues," in which Ella does a "Satchmo" type vocal, make the disc something of a collectors' item and well worth having, particularly at the record club price.

"Lullaby Of Birdland," "Rough Riding," "Angel Eyes," "Smooth Sailing," "Oh, Lady Be Good," "Later," "Ella Hums The Blues," "How High The Moon," "Basin Street Blues," "Air Mail Special," "Flying Home."

The audio quality is good, although not quite up to the "excellent" label. (KWJ.) ■

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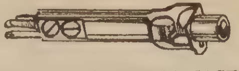

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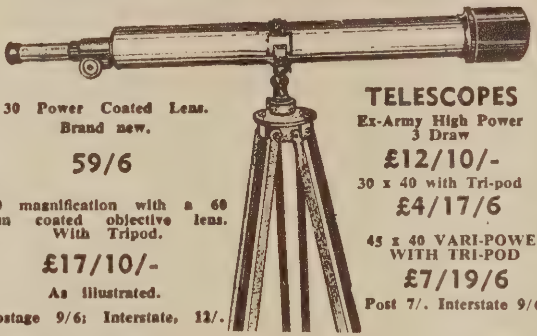

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TRADE REVIEWS AND RELEASES

EMPIRE 888P CARTRIDGE PERFORMS WELL

The Recorded Music Salon, of 23 Collins St., Melbourne, advise that they are sole Australian agents for the hi-fi products of Empire Scientific Corporation. For our inspection and review they have submitted an Empire model 888P magnetic pickup cartridge.

OME years ago, an earlier model Empire cartridge occupied pride of place as r "favourite" for home listening. At a ne when many of the big-name cartridges l had their rough edges, the Empire (the) series, I think) had a smooth, clean und that commended it immediately to e's ear. I was dismayed when an accident ptured the stylus system and completely attered when I discovered that it could be paired only at the Empire factory!

The new 888 series employs the same oving magnet principle as the earlier types t I understand that the stylus assembly now much more amenable to service and placement. According to the accompany- literature, the whole stylus assembly can nply be withdrawn from the body of the rtridge and, as a matter of interest, reced with alternative assemblies (elliptical lus, etc.) from the same series.

The cartridge itself is only about half volume of the early series, being essenly contained in a tube about ½ x ½ x inch, with a moulded tip which surunds and supports the stylus. It follows modern philosophy of being light, as ll as small, and when mounted in a head ell by its normal brackets (standard 7-16 ½-inch centres) the stylus assumes what now regarded as the standard vertical cking angle of 15 degrees.

Complete mu-metal shielding minimises kup from stray hum fields and, in this pect, the cartridge appears to be comtely adequate and much superior to the lier type referred to above. There is no cernible leakage from the cartridge's own gnetic system, so that it can be used h steel turntables, if necessary.

Electrically, the cartridge would appear qualify for description as a "medium pedance" device, suitable for operating o preamplifier systems with an input imdance in the region 47K to 100K or into impedance transistor systems which rely the cartridge inductance for some of ir bass compensation.

Our own tests were done through a Playster No. 10 Control Unit, using four EF86 ntodes, and which offered exact RIAA npensation and about the right amount overall gain. Nominal output, in the 6 8 millivolt region, is much the same as ner comparable and competitive cartridges.

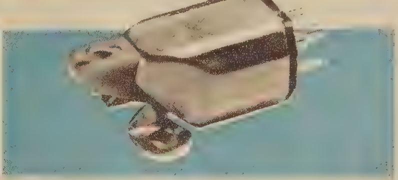
The literature lists three versions of the rtridge:

(1) The 888, fitted with a 0.7 mil diand stylus (coded brown), a compliance of ucM/dyne and a claimed response of 24,000cps. Playing weight ¾ to 6 grams.

(2) The 888P, fitted with a 0.6 mil and-polished" diamond stylus (coded nge), a compliance of 15 ucM/dyne and laimed response of 8 to 28,000cps. Play- weight ½ to 4 grams.

(3) The 888PE, fitted with a 0.2 x 0.9 radial hand-polished elliptical diamond lus, a compliance of 20 ucM/dyne and a imed response of 6 to 30,000cps. Playing ight ½ to 3 grams.

On listening test, the model 888P, subted for review, left no doubt as to its



general smoothness, its clean sound and good channel separation. In the realm of high quality cartridges, this statement is not unique, these days, but the Empire is worthy of any comparison which highly critical listeners may care to make.

As a check on frequency response, the Control Unit was set for RIAA compensation with the variable controls nominally level, then critically adjusted to give a level response off the record. This done, the measurement of response over the entire range up to 10KC became a formality, with the output meter varying no more than about 0.5dB from reference on any track.

Treble resonance appears to occur in the 12KC region, with a gentle roll-off beyond; it may be hard to justify the maker's claims of 28,000cps, although this would seem to be of largely academic interest. In our tests, done with a playing weight of 2 grams, one channel exhibited a peak of less than 1dB at 12KC but the other was nearer 3dB. Our experience of a small 12KC peak corresponds with "Hi-Fi Stereo Review" (July, 65) but conflicts curiously with Percy Wilson's findings ("Gramophone," April, 65) which suggested heavier internal damping and a response which was actually rolling off in the 12KC region.

There is common agreement, however, on the excellence of the waveforms throughout the range.

Stereo separation was better than 20dB over most of the range, diminishing to about 12dB in the region of system resonance and above.

Messrs. Recorded Music quote the price of the 888P as £18 retail, the unit being attractively packaged and complete with mounting hardware. The 888 is somewhat cheaper at £16 retail, while the 888PE retails at £26.

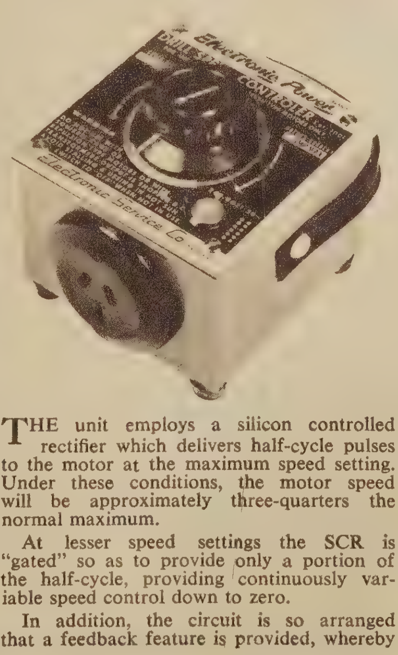
Trade inquiries should be addressed to True Fidelity, 23 Collins Street, Melbourne. Sydney sub-agents are Phodis Pty. Ltd., 405-411 Sussex Street, Sydney. (W.N.W.)

OTHER PRODUCTS: Messrs Recorded Music advise that they are expecting substantial shipments of Empire loudspeakers and turntables. An initial shipment of Model 8200 loudspeakers was sold on the same day that the first sample was put on display.

Also available through Recorded Music Salon is the full range of Armstrong products, including the Armstrong 221 amplifier.

CONSTANT TORQUE CONTROL

Recently to hand from the Electronic Service Company is a very effective speed controller for portable power drills and similar appliances employing series-connected brush type motors. Providing essentially constant torque characteristics, it adds greatly to the usefulness and versatility of such tools.



THE unit employs a silicon controlled rectifier which delivers half-cycle pulses to the motor at the maximum speed setting. Under these conditions, the motor speed will be approximately three-quarters the normal maximum.

At lesser speed settings the SCR is "gated" so as to provide only a portion of the half-cycle, providing continuously variable speed control down to zero.

In addition, the circuit is so arranged that a feedback feature is provided, whereby an increase in load applied to the drill results in the SCR turning on earlier in the cycle than under no-load conditions, thereby increasing the effective power as the load is applied. The result is a nearly constant speed under varying load conditions.

The unit is rated at 240V, 2.5A, and is suitable for most portable drills up to ¼in chuck size. Users of ½in drills would be wise to check the total current of their particular unit if in doubt.

The unit is housed in a stout plastic case, fitted with rubber feet and suitabley ventilated. A single large control knob on the top of the case provides both "ON/OFF" switching and speed control. A standard 3-pin outlet is provided, plus 6ft of cab-type flex for connection to the power point.

Tested in our own workshop with a typical portable drill, the unit substantiated all the claims made for it and, even at very low speeds, provides a surprisingly high torque. Particularly where a drill can be mounted vertically in a drill stand, it will convert a simple drill into a versatile multi-speed unit.

Price of the complete unit is £12, plus 12½ p.c. where applicable. The unit is also available in kit form for £9, plus tax as above.

Further inquiries should be directed to Electronic Service Company, 15 Tallawalla St, Beverly Hills, N.S.W. (P.G.W.)

A.P.T. REGULATED POWER PACKS

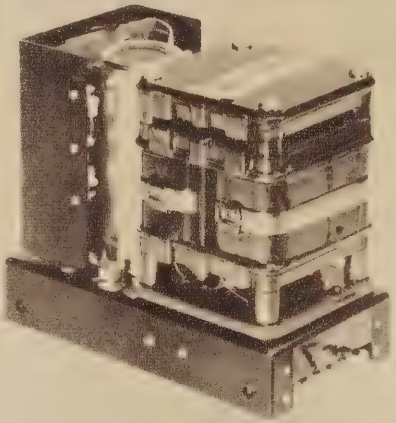
E.M.I. (Australia) Ltd. announce the availability of a series of low voltage regulated power supplies, manufactured by A.P.T. Electronic Industries Ltd., of England. They are suitable for use as laboratory power supplies or for incorporation into larger pieces of equipment.

THE units are available in a range of output voltages from 6 to 30, preset at the factory to the customer's requirements. However, they can also be modified in the field, with very little effort, to deliver any other voltage in the above range.

A range of units is available with current ratings from 0.5A to 10A, the unit submitted to us and illustrated being the TSU-112, rated at 1A at 12V. Overload protection is provided, the output dropping to zero immediately it exceeds the rated maximum. Output is restored by removing the overload and switching off the mains supply for five seconds.

The unit is designed to maintain an essentially constant output over the full range of output current, or for a mains voltage variation of plus or minus 10pc of nominal. The output resistance is given as ranging from .01 ohm at 6V to .05 ohm at 30V, and output impedance less than 0.5 ohm at frequencies up to 500KC.

The ambient temperature range is quoted as minus 10 to plus 45 degrees C.



A novel feature of the device is the provision of separate terminals for the input to the controlling amplifier, thus allowing this to be connected directly across the load and provide constant voltage across the latter, rather than the output terminals, regardless of losses in the connecting cables.

This facility is normally provided on t TSU-200 (2A) and larger units, on t assumption that currents of this order cou create problems in regard to cable loss However, the same facility can be ma available on the two smaller models, t TSU-0500 (0.5A) and TSU-100 (1A) eith on request to the makers, or in the fie by reference to the circuit diagram.

In all models the control amplifier constructed on a plug-in printed circu board for ease of servicing.

Both output terminals are insulated fro the frame and the units may be connect in series with any other voltage sourc up to a maximum of 500V.

Tested in our laboratory, the unit pe formed exactly as described. There was discernible variation in output voltage f a mains voltage variation between 190 a 265V (the most we could provide) wh under full load. The overload protectio which is completely electronic, is rapid a reliable.

The unit is solidly constructed and w made, and built in a form which len itself to incorporation in a manufacture own equipment. The TSU-1 measur 6½in x 3½in x 5½in high, and weighs 5¾ The TSU-0500 measures 5-5/8in 3-1/16in x 2¾in. The chassis is provid with four 4BA bushes for mounting.

Further inquiries should be directed E.M.I. Australia Ltd., 301 Castlerea Street, Sydney, N.S.W.—(P.G.W.)

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MODEL 580
Unidirectional Dynamic Microphone

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- Uniform shaped response, particularly suitable for the professional entertainer.
- Shock mounted for quiet operation.
- A built-in "ON-OFF" switch with provisions for locking switch in its "ON" position.
- Versatility—for use in the hand or on a stand —for use indoors or outdoors.
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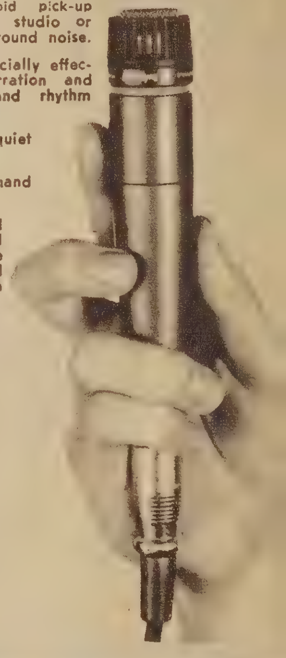
The Model 580 Series Unidyne A Microphones are moving coil dynamic units built to provide wide-range reproduction of music and voice and featuring an excellent unidirectional microphone pickup pattern. These unidirectional microphones are ideal for quality public address, theatre-stage sound systems, recording and other reinforcement applications.

MODEL SM57 MICROPHONE

FEATURES

- Unusually effective cardioid pick-up pattern minimises effects of studio or location acoustics and background noise.
- Bright, clean sound. Especially effective for announcing, narration and dialogue, vocal music and rhythm pickups.
- Shock-mounted for quiet operation.
- Versatility—for use in the hand or on a stand.
- The microphone is supplied with an adjustable swivel adapter which permits the microphone to be tilted through 90 degrees from vertical to horizontal.

The Model SM57 is a slender dynamic microphone built to provide wide-range reproduction of music and voice. It features an exceptionally uniform and effective unidirectional pickup pattern. The performance characteristics and unique construction make it ideal for both studio and remote use in broadcasting, recording, motion picture and critical sound reinforcement applications. It is especially suitable for interview type use where 'hand-ability" of the microphone is important.

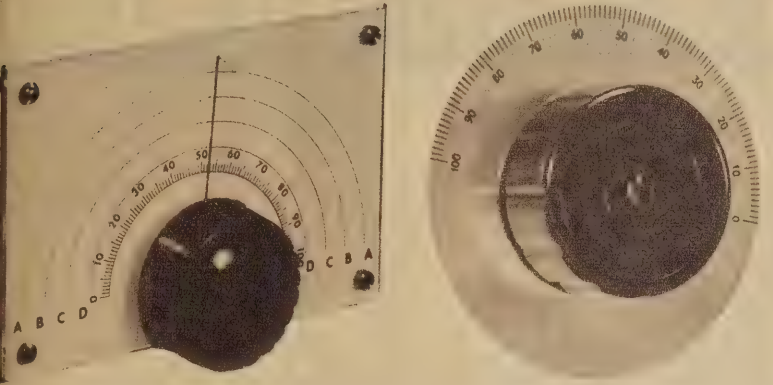


AUDIO ENGINEERS PTY. LTD.

NATIONAL DISTRIBUTORS FOR SHURE BROS.

342 Kent Street, Sydney. 29-6731.
60 Berwick Street, The Valley, Brisbane. 51-5535.

TRADE RELEASES—IN BRIEF



Two new calibrated dials available from Watkin Wynne Pty. Ltd., 32 Falcon St., Crow's Nest, N.S.W., or from parts suppliers. Type JB6/36 (left) features twin vernier drive, 6:1 forward and 36:1 reverse, metal backing plate, solid Perspex front panel, four blank scales and 0-100 logging scale, and transparent cursor. Size 4 x 3½in. Type JB461 (right) is a moving scale instrument dial with inbuilt 6:1 reduction drive. The 4in. diameter dial is polished aluminium. A fixed transparent cursor plate with hairline is supplied. Prices have not yet been released.

AMALGAMATED WIRELESS (AUS-RALASIA) LTD. advise that their service epartment can now offer a tuner exchange rvice, for AWA tuners only. Charges for e exchange repair service (excluding eight and replacement of broken, defective nd/or missing valves, which will be harged extra), will be at the following tes:

13-channel tuners, £3/2/6 ($6.25).

10-channel tuners, including conversion 13-channel operation and supply of 13-hannel selector knob, £5/18/6 ($11.85).

A 10-channel to 13-channel tuner con-ersion table is available on request to cognised servicing organisations. (Amal-amated Wireless (A'asia) Ltd., Service epartment, 67 Lords Road, Leichhardt, .S.W.)

MICROCOMPUTER

Continued from page 9

omputer within 1.5-2 microseconds to ny device needed to communicate rgent information. Requests are andled on a priority basis through eight eparate interrupt channels. The main rogram is undisturbed while the com-uter deals with such interrupts.

The final refinement of Myriad is the e of programmed fault-finding, which iminates the need to employ a first-rade service engineer. Any failure is rst traced easily, by tests and diagnostic rograms, to one of the functional main oards, which is slid out. If resumed orking is urgent, a fresh set of sub-oards can be plugged into another main oard and operations resumed within 10 inutes. Given more time, a failure may e narrowed down to a sub-board, and nally to one tiny semi-conductor pack-ge, which is replaced.

One result of this system is economy holding spares, since throwaways ould usually consist of single, standard-ed, cheaply replaced plug-in units.

The failure rate when Myriad is work-g is as yet unknown. Failure-tests with prototype computer have reached tens f millions of component-hours—so far ithout result. ■

FERRIS BROS. PTY. LTD. have released details of the following new products:

Ferris "Volumatic" car radios are now available for 6V operation. These sets feature nine transistors, four-stage permeability tuner followed by two stages each of IF and AF amplification, with choice of manual or push-button tuning. Prices are the same as the 12V version. Model 152, manual, £46/4/ ($92.40); Model 159, push-button, £51/9/ ($102.90).

A new design of power cradle for Ferris portable car radios, with built-in lock, has been produced, designed to provide a theft-proof installation. The power cradle has a release lever and lock. When the radio is inserted in the cradle, and the lever pushed back, the lock operates automatically. The lever is located on the opposite side of the cradle to the lock, and the design is such that the set cannot be removed from the cradle without operating the lock, even if the lever is forced around 180 degrees from the locked position.

The Ferris Channel Master "Tenna-Tie" inter-action filter for joining high- and low-band aerials to a single down lead has been restyled. A feature of the new design is insulation-piercing terminals which make it unnecessary to strip insulation from wires before connection. Retail price is £3/3/ ($6.30). ■

AUDIO TOPICS

Continued from page 83

1965 (p.614) E. A. Harman suggests that the inclusion of fibrous filling material in a labyrinth can multiply its effective length by two or three times, as well as affecting other dimensions. It does this by adding mass to the air in the tube.

Harman suggests that, since this mass-velocity effect is likely to be most apparent in the labyrinth system, the latter may have most to gain from the filling technique.

While it may be too much to look for a labyrinth of "bookshelf" dimensions, there may be good reason to think in terms of high performance labyrinths, of total volume about five to six cubic feet and, interestingly enough, tuneable by the simple process of adding to, or removing filling from/to the tube. ■

BUSINESS SUCCESS IS WON BY NIGHT

In order to deal efficiently with the thousand and one problems which come his way in the course of a day, today's businessman has to be a practical psychologist, an expert at selecting, placing and motivating staff, a past master at writing action-getting letters and reports, a skilled negotiator able to communicate effectively with others. He must possess the ability to sell his ideas and himself, be a capable public speaker, an inspiring leader, a top-class manager and administrator. He must have a sound understanding of all the major profit-producing factors in business. He must be a creative thinker, a problem solver, able to conduct fruitful meetings. He must understand the problems related to advertising and public relations. In order to make fruitful decisions he must be acquainted with modern marketing methods, motivational sales management and dynamic retailing. He He must be equipped to draw a correct diagnosis from financial statements, and when credit is called for he must know the many avenues which are available today for raising capital in the financial world. He needs to have an understanding of economics, the stock exchange, investment matters, and must be equal to every social occasion and be able to play "the host with the most" when entertaining VIPs. A tall order if ever there was one but nevertheless imperative.

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AMATEUR BAND NEWS AND NOTES

New Record for Two-way DX on 144Mc

Two-way contacts on 144MC between Australia and New Zealand became almost commonplace during November and December 1965. During this period a new Australasian 144MC record was set.

By Pierce Healy, VK2APQ*

WITH the advent of summer, VHF operators in Australia turn their attention to DX contacts. In the past these contacts were regularly made between all Australian and New Zealand call areas on the 50MC band and in more recent years, due to the change in frequency allocations, on the 52MC to 54MC band.

However, it is only during the past three or four years that two-way contacts across the Tasman on 144MC have assumed any measure of consistency. During this period contacts have been made between stations in New Zealand and stations located within about 60 miles airline of Sydney, N.S.W.

The Ross Hull Memorial Contest conducted by the Wireless Institute of Australia to encourage activity on the Amateur VHF bands has done a lot towards stimulating interest in investigating the possibilities of making 144MC contacts between the two countries.

In November and December, 1965, not only did the 144MC band open as expected to New Zealand from Sydney, but on December 8 and 9 a blanket opening occurred and contacts were made with New Zealand stations from VK2, VK3 and VK5 call areas. For the first time all New Zealand call areas were contacted by Sydney stations, while contacts were made between ZL2 and VK3; ZL3 and VK5 call areas.

On December 9 the opening to the Sydney area lasted about two hours when up to 12 New Zealand stations were heard with signals up to strength 9. This opening commenced about 1710 hours EST.

Openings also occurred on December 13 and 15 at 1700 hours EST when ZL3 and ZL4 stations were heard with signals up to strength 9 by Sydney stations.

The highlight, however, was the establishment on December 9 of a new Australasian distance record for a two-way contact on 144MC.

This record breaking contact took place at 1815 hours South Australian time (2045 hours New Zealand time), between VK5BC located in Berri, South Australia, and ZL3AAD in New Zealand. The distance approximately 1600 miles.

Hugh Lloyd, VK5BC, told the story of the contact in these words.

"The six-metre band was wide open to New Zealand at the time with very little QSB and not much activity to other areas. Signals from ZL2 call area were very strong and steady. The sporadic E conditions appearing very high.

"Listening on 144MC during this period showed that the noise level was rising and subsequently an odd carrier or two appeared gradually rising in signal strength.

"At the same time it appeared that the New Zealand stations had worked quite a number of New South Wales stations on 144MC. About 1800 hours S. Aust. time I worked ZL3AAD on six metres and he told me of the VK2 stations coming through and we agreed to try a check on 144MC. As a result, we exchanged signal reports of Readability 5, signal strength 7 to 8, at 1815 hours.

"The path to ZL3AAD remained open for a quarter of an hour following the contact, the carrier being audible at S 4 to 5. No other stations were identified during this period but several carriers without modulation were heard."

Lloyd considers that the contact was due to Sporadic E conditions very similar in nature to his contacts with VK2 and VK4 stations of previous years. The temperature was a modest 85 degrees but the humidity had been unusually high for a long period.

The equipment used by VK5BC was: Receiver — Push-pull 6J6 — P.P. 6J6 — 6C4 cathode follower to a BC348 Receiver as the tuneable IF. Transmitter 6V6 — 7C5 —QQE03/12 — QQE06/40 P.A. at 90 watts input. Modulator, Class B 807s. Antenna, 10 element long Yagi 45 feet high with a excellent take-off to the east southeast.

It was also on December 9 that Graeme Sutherland, VK3ZAA, put Victoria on the 144MC DX list by being the first in that State to make contact with New Zealand on the 144MC band. In all, three New Zealand, ZL2, stations were worked.

Graeme's report on the contacts is: "Three contacts were made with ZL2 on December 9, 1965, as follows:

1715 EST ZL2HP—
Signal report given R5 S7, Rec'd R5 S6
1720 EST ZL2AAH—
Signal report given R5 S8 Rec'd R5 S5
1725 EST ZL2AJB—
Signal report given R5 S8 Rec'd R5 S5

"The first two contacts were rock steady and could have been taken for local signals. However, QSB set in on the third contact and conditions deteriorated quickly.

"The rig here runs 70 watts to a QO106/40 final and the antenna is a five over five element yagi about 35 heet high.

"The converter is a standard VK3APB tyne using a ECC 88 RF stage and feeding into an unmodified BC348 receiver.

"ZL2HP was running 70 watts to a four over four element yagi antenna about 30 feet high.

"All openings to date appear to have occurred between 1700 hours EST and 1900 hours EST with the best signals between 1700 hours and 1730 hours EST."

The news was also given by Graeme that during the following week VK3ZCR worked ZL3TAT and VK3ZNC in Geelong worked ZL2HP. Both VK3ZAA and VK3ZCR are located in Melbourne.

There is also mention that a VK7ZL contact took place during the same period, but no confirmation has been received.

Observations made by VHF operators in Sydney, during December, of the 144MC openings to New Zealand, reveal that most of the openings occur during the periods just before or after sunset between the hours 5pm to 7pm.

There did not appear to be any tie-up with local weather conditions as New Zealand stations were worked on fine warm and still evenings as well as when it was wet and windy.

However, all the openings coincided peaks in six metre signals indicating both two and six metre signals share common path—possibly Sporadic E.

It also appeared that one way skip place as VK2 signals had been heard New Zealand and vice versa, but two contacts were sometimes impossible or cult. Openings took place on more 25 per cent of the days in December, t being more than 10 individual openi

OSCAR IV

The launching of the Oscar IV sate took place on Wednesday, December However, due to a technical failure in launching vehicle, Oscar IV, along three other experimental satellites, did go into its planned orbit.

A report heard on December 26 st that Oscar IV was in an elliptical orbi 106 miles to 21,000 miles from earth an orbital period of 600 minutes and systems were working.

The beacon frequency is 431.932MC it is transmitting the "HI" signal slowl Morse code. The translator frequenc 10KC higher than the beacon, 431.942MC. The translator input freque is 144.1MC, plus or minus 5KC.

Signals have been received in Sydney VK2ZBJ; VK2ZCF; VK2ZPT; VK2Z and VK2AAK. On December 24, sig from the beacon peaked at Strength but on December 26 the maximum si was S3.

Early reports on the reception of sig via the Oscar IV translator were from Jenkins, VK2ZBJ, who heard CW sig from VK7PF and a very readable si from VK2ZPQ over an estimated re path of 5,000 miles.

From overseas, early reports were contacts had taken place between W4 W6 stations; also between DL9 and

RETURN HOME

The December issue of these notes the story of the experiences of Hov Rider, VK3ZJY, a Colombo Plan educa officer in East Pakistan, in his attemp obtain an amateur licence and forn radio club, along the lines of the Wire Institute of Australia, Youth Radio Sche at the Khulna Polytechnic Institute.

On Thursday evening, December 16 was my pleasure and privilege to be first to welcome Howard back to Austr and to spend a very enjoyable and ed tional two hours with him prior to his tinuing his journey home to Melbou

Words cannot describe Howard's plea at being back in Australia, but his en siasm to continue the task he set ou do is unchanged. Physically, despite loss of over two stone in weight, he he was quite fit, but nevertheless loo forward to restoring the "avoirdupois" some good Australian tucker.

In addition to relating some of experiences, and what must be appa conditions compared with Australian s dards, in East Pakistan, Howard told the conditions under which radio licences were issued in that country.

An interesting point, probably not kn to many amateurs, is the method of allo call signs. AP2 prefix is issued to indivi operators, while AP5 is issued to stations.

Some of the conditions under which licence was issued to the radio clut the East Pakistan University of Engir ing and Technology, Dacca, are:—

"The combined height and length of aerial shall not exceed 200 feet.

"The power used with the transmi apparatus shall not exceed 100 v measured at the input to the aerial cir

"Communications may be sent at any ne, provided that, except with special rmission, the time occupied in transssion shall not exceed two hours during y consecutive period of 24 hours.

"Transmission shall at once be disconued or postponed at the request of any overnment or commercial station.

" . . . Special gramophone records for producing modulation of definite tones ay be used, but not more than one ordiry gramophone record during the course a day with the exception that the record ay be repeated.

"The use of the general call 'CQ' is pressly forbidden. The word 'test' followed the word 'from' or the procedure signal E' and the call signal of the licensee's ation may, however, be sent out when sential for the licensee's experiments, but is method of calling must not be conued in any case when a reply is not ceived from another experimental station thin 15 minutes.

"The licensee shall observe the provisions the International Telecommunication onvention, Geneva 1959, and the General adio-Communication Regulations annexed reto so far as they are applicable to perimental stations and any modifications the said convention or regulations or ose of any subsequent International Conntion which may replace it from time to ne."

From a page of a magazine article, titled 'iger Amateur Radio Club," come further tails on amateur radio in East Pakistan. The article tells of the efforts the soldiers the Corps of Signals have made in prooting the cause of amateur radio.

"The history of the club goes back to e days when the first station by the call n AP5CP was inaugurated by Brigadier . Zaman Khan, the then Signals Officer-Chief, in April, 1952, in the lines of gnal Regiment. The seeds of the Club ere sown with the inauguration of this ation, which ultimately grew into a full-dged club known as 'Tiger Amateur Radio lub.'

"Initially the main efforts were devoted bringing this station on the air but due extreme scarcity of equipment, literature d other guidance material, it could not be hieved earlier than July, 1961.

"Being the first amateur radio station in ast Pakistan, AP5CP soon attracted the tention of a large number of radio amaurs all over the world. The station, thus, ithin a short span of one year won a rge number of awards and certificates for outstanding performance in various ternational contests and competitions."

The article listed three stations, AP5CP; P5JA; and AP5SS as those operative since ne, 1962.

AP5EU, The University of Engineering ation at Dacca, was issued with its licence February, 1965.

It is not known yet if or when Howard ider VK3ZJY will be returning to Khulna, ast Pakistan. It is known, however, that return to Melbourne he immediately newed his active interest in the Youth adio Scheme.

There is no doubt that Howard's experices have given Australian amateurs someing to think about and to realise how uch better off we are than those fellow nateurs endeavouring to operate in an nder-developed country.

THE TVI PROBLEM

The activities of amateur stations operang on the six metre band, 52MC to 54MC, Melbourne and Brisbane are severely rericted through interference to television ceivers tuned to Channel 0 which oper-es on 45MC-52MC.

Despite the fact that the amateur transitters are adjusted and operating within e standards laid down by the P.M.G. epartment, the interference sometimes ccurs several miles from the amateur staon concerned. This is, in general, due to e broad-band characteristics of television ceivers.

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Successor to the popular HE-30, the new HA-230 features improved performance and attractive modern styling to make today's best value receiver buy backed by LAFAYETTE'S exclusive money-back guarantee.

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- Effective Automatic Noise Limiter.
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- Stable Oscillator and BFO for Clear AM CW and SSB Reception.
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Outstanding Bandspread, Selectivity with a built-in Q-multiplier, and sensitivity combine to maka the HA-230 one of the "hottest" general coverage bandspread receivers LAFAYETTE have ever offered. A special filament transformer provides continuous voltage on critical oscillator and mixer stages to maintain frequency stability, prolong tube life, and give faster "warm up." Electrical bandspread calibrated on amateur bands 80 through 10 metres and an 0-100 logging scale make the HA-230 an ideal receiver for amateurs and SWL's.

Receiver Sensitivity—1.0 microvolts for 10 db Signal-to-Noise Ratio. The built-in BFO can be used to separate CW stations by means of the pitch control, while the Q-multiplier adds the selectivity needed for crowded phone band operation.

Front Panel Controls: FUNCTION SWITCH, AUDIO GAIN, SELECTIVITY (Q-Multiplier), FREQUENCY (BFO), BAND SELECTOR, IF GAIN, ANTENNA TRIMMER, AVC-MVC SWITCH, ANL SWITCH, MAIN TUNING, BANDSPREAD TUNING, HEADPHONE JACK.

Tubes: 3—6BA6, 2—6BE6, 2—6AV6, 1—6AQ5, 1—5Y3. For 220-240 VAC.

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MACK'S ELECTRONICS, 199 Rundle Street, Adelaide, S.A.
WINDSOR SERVICES, Smith Street, Darwin, N.T.

The worst interference, however, is suffered by the Channel 0 viewers among the near neighbours of the licensee and these are those most likely to make their displeasure known.

It is possible, with the co-operation of the Channel 0 viewer, for the amateur to eliminate most of the trouble from the offending television receiver up to within a few hundred feet of the amateur transmitter.

In an attempt to maintain good relationship with neighbours without restricting the activities of amateur stations in Melbourne and Brisbane, during the DX season, a suggestion has been made by the VHF Group of the Victorian Division of the W.I.A.

The suggestion is to fit an RF trap consisting of two feet of three hundred ohm ribbon and a 30pF trimmer, taped to the feeder of the offending receiver.

Full effectiveness of these traps cannot be achieved unless the amateur's operating frequency is well separated from Channel 0, preferably above 53MC and restricted to within 100KC of the frequency the trap is tuned to.

It is suggested that as a standard practice each Melbourne and Brisbane amateur operator select his own trap frequency above 53MC. Then if possible fit and tune traps to this frequency to the nearby neighbour's offending receiver and use that frequency in preference to all others within the six metre band.

During DX openings a number of stations outside Channel 0 areas use frequencies near the 52MC band edge, and to ensure contacts with these stations it is essential to call them on or near their frequencies.

In such cases it is suggested that the initial call only be made on the lower frequency and as soon as communication is established the 'Channel 0 amateur' should state his trap frequency and move to that frequency. This could be carried out by a standard procedure, such as "I will QSY to trap frequency (e.g. 53.22MC)," repeated twice.

For any measure of success it is most important that this operating procedure be recognised and acted upon by other than 'Channel 0 amateurs'. All divisions of the W.I.A. have been requested to publicise among their six metre operators, the possibility of encountering such a procedure so that they will be prepared and able to tune to the new frequency, or perhaps persuaded to operate more on the higher six metre frequencies.

To Melbourne and Brisbane amateur operators some or all the following methods are recommended for minimising Channel 0 TVI;

1. Use vertical polarised beam antennae.
2. Operate above 53MC on one frequency only.
3. Use low power.
4. Fit traps to complainant's television receiver, tuned carefully to the frequen selected.
5. Use narrow band frequency modu tion.

To all other six metre band operato look for the 'Channel 0 refugees' up ne the top end of the band.

CORRIGENDUM

The par in the November issue of the notes, referring to the first Australian am teur to take advantage of the Reciproc Licensing agreement with the United Sta of America, was incorrect.

The person to whom the honour righ goes is Dave Medley, VK3DL/W5 oper ting from Richardson, Texas, U.S.A.

In a letter received from Dave, he cla fied the position and gave some details his activities.

"I am active on 14MC CW, usually or around 14075KC during the weeken between 1300Z — 1500Z and 0600Z 0800Z and would appreciate VK contac

"Many stations I feel tune away as so as they hear VK3 and before the /V comes at the end, so I find it hard to ma QSO's. For this reason I try to operate or about the same frequency and wou appreciate any publicity you may care give me."

Incidently, Dave operated as VK3MJ f many years and took part in the fi interstate QSO on 50MC with Don Kno VK2NO, also with VK5AE in Darwin.

Satellit

A world range Hi-Fi battery/mains portable by

Satellit . . . the portable that sets the standard by which all other portables are judged. One look tells you that this is an exceptional receiver, designed to satisfy the most meticulous radio enthusiast.

Through two Superphon ceramic magnetic loudspeakers, the Satellit gives you world-wide reception on thirteen wavebands—with a depth and clarity that has to be heard to be believed!

The Satellit is designed to operate on batteries or A.C. mains, and receives VHF/FM, Long, Medium or Short wavebands. Short-wave coverage ranges from 10 to 187 m., split into 4 bands. Additionally, six bandspread short-wave ranges are provided, shown on separate scales with a rotating drum selector. The Satellit is fitted with 17 transistors and 11 diodes. It features a short-wave fine tuning dial, automatic frequency control on FM, RF stage for all wavebands, a switchable ferrite aerial, a separate control for the bandspread short-wave tuner, duplex drive on FM/AM, a tuning and battery power meter, and two multi-octave loudspeakers.

The Satellit also has an illuminated tuning scale and separate bass and treble controls. Sockets are provided for headphones, external aerial and earth, car aerial, record player, tape recorder and external battery power supply.

The Satellit 5000 has a handsome padded graphite case with chrome and satin silver trim. It measures 16" x 10" x 4¾". Switch on the Satellit and you may wish you hadn't. Your old radio set will never sound the same again.

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GE:P249

WIRELESS INSTITUTE ACTIVITIES

reparations for the Federal Convention the Wireless Institute of Australia are ming the attention of Officers and mem- interested in furthering the activities Amateur Radio, particularly the Queens- Division who will be acting as hosts the Convention to be held in Brisbane Easter.

mong the major items on the agenda the final draft of the proposed new eral Constitution. It is possible that agreement may be reached on this ter.

NEW SOUTH WALES

Members, some accompanied by their es, who attended the December meeting e treated to an armchair trip around world. The screening of a large num- of coloured slides and an interesting mentary enabled those present to enjoy pleasure of learning about many places ch previously were only names.

The guest who provided such a pleasant ning's entertainment was Ron Rye, D.C.A. engineer who took the shots ing a business trip investigating special o equipment for the Department. The io interest was catered for by shots of e of the large and well-known manu- uring companies and a few words on r products.

VHF AND TV GROUP

During December there were several good nings to all States on the 52MC band some good scores in the Ross Hull morial Contest were made. These were ewhat over-shadowed by the excellent nings to New Zealand on 144MC. The extent of VHF band conditions will bably be revealed in the results of the test.

The Christmas party held at the home of Group Chairman, Paul Jackson, 2ZPJ, was a very pleasant evening, with nbers, their wives and friends present, lling more than 70. However, the MC hidden transmitter hunt preceding party baffled most of the contestants.

tocks of the first and second sections the publication "Amateur Guide" which tain many useful articles and hints on F and other equipment are now avail- e.

These can be obtained by writing to ndbook," Wireless Institute Centre, w's Nest, N.S.W., or may be collected n W.I.C. at the Disposal Section.

Cost, including postage: First Section 10/, ond Section 6/. Material is being as- bled for the Third Section and will be ilable during the first half of 1966.

Equipment is being installed at W.I.C. that the VHF news broadcast can be de from that location on Sunday nights. s broadcast covers subjects other than F and can be heard on the 144MC band.

HUNTER BRANCH

The Hunter Branch of the New South les Division of the W.I.A. held a very cessful Summer Field Day at Bolton nt on the shore of Lake Macquarie, Sunday December 5, 1965.

Although the weather was a little wet id not deter a large gathering from taking t in a well organised program of mobile MC and 7MC events.

The winners of the events were:—

Mobile All Band Scramble: Dave drews VK2AWZ.

Hidden Transmitter Hunt 144MC: David cNaughton VK2ZVW.

44MC Transmitter Hunt on Foot: David cNaughton VK2ZVW.

Hidden Transmitter 7MC: Dave Andrews 2AWZ.

Hidden Transmitter Hunt 144MC: Max ncis VK2BMK.

Christmas Cake Raffle: Harold Burtoft 2AAH.

Consideration is being given to the pos- lity of holding a similar outing in the umn.

CENTRAL COAST BRANCH

The highlight of the year in the Central Coast is the Annual Field Day of the Branch held at Gosford. This year the date is Sunday February 27th.

As usual a full program of events and scenic tours has been planned. An outline of the program is as follows:

9.30 a.m. Registrations — Morning tea and scones.

9.30 a.m. - 10.00 a.m. All Band Mobile Scramble.

10.45 a.m. 144MC Hidden Transmitter Hunt.

11.30 a.m. - 11.45 a.m. 144MC Scramble for XYL's.

12.00 - 12.45 p.m. First serving of Lunch.

12.45 p.m.-1.30 p.m. Second serving of Lunch.

1.00 p.m. - 1.20 p.m. Disposal shop.

1.45 p.m. - 3.45 p.m. Ferry Boat trip on the Brisbane Water or a Tourist Bus trip to Norah Head.

2.00 p.m.-3.00 p.m. 144MC Hidden Transmitter Hunt.

4.00 p.m. Afternoon Tea.

4.45 p.m. Prize giving and farewells

Ice cream — Soft Drinks — Oranges. 809's will be available. Transport will also be available to those wishing to swim at the Olympic Swimming Pool.

The venue for this most popular Field Day will be the Gosford Race Course. Visitors travelling by train will be met at the Gosford Railway Station.

Trains leave:— Sydney — 7.30 a.m. arrive Gosford 9.00 a.m.; 8.30 a.m. arrive Gosford 10.00 a.m.

Newcastle — 7.33 a.m. arrive Gosford 9.07 a.m.

Registration fees:— Double £1-0-0; Single 12/6, Children 5 years of age and over 2/6.

At the last meeting in 1965 Lindsay Douglas, VK2ON gave members an interesting talk illustrated by colour slides of his recent trip overseas to Canada, United States and Great Britain.

Alec Swinton VK2AAK, was appointed N.S.W. Co-ordinator for the Oscar IV project and has been kept busy collecting and correlating information on the experiment.

Another student of John Deering's VK2ND A.O.C.P. class has been successful in gaining his Limited Licence. He is Peter Kerr of Gosford.

Branch meetings are held on the third Friday of each month in the School of Arts, Gosford. Visitors are always welcome.

NARRANDERA AMATEUR RADIO CLUB

News from Narrandera tells of the resignation of the club president, Don Fullerton, VK2DU and the appointment of Harry Cuthbert, VK2AEC, to that position.

Don has been posted to Katoomba, one of the perils said to be encountered in the

REMEMBRANCE DAY CONTEST RESULTS

Honours in the 1965 Rememberance Day Contest held last August, went to South Australia by a large margin from Queensland and New South Wales.

The final State Scores were:

South Australia	4,172 points	Western Australia	2,316 points
Queensland	2,592 points	Tasmania	2,096 points
New South Wales	2,495 points	Victoria	1,311 points

DETAILS

State	Log entry	Licences	%	State Total score	Aver. top six logs	State Points
New South Wales	109	1,275	8.6	19,751	796	2,495
Victoria	62	1,135	5.5	12,508	623	1,311
Queensland	68	505	13.5	13,174	814	2,592
South Australia	91	460	19.8	18,096	769	4,172
Western Australia	56	250	22.4	8,080	506	2,316
Tasmania	32	140	23.0	6,605	590	2,096

AWARD WINNERS

Open Section

VL1VK—S. Grimsley	622 pts.
VK2AHM—R. Whyte	1116 pts.
VK3XY—R. Prose	663 pts.
VK4RH—A. L. Hoey	1091 pts.
VK5NO—L. H. Vale	1226 pts.
VK6SM—W. H. Saw	510 pts.
VK7DK—D. H. Kelly	938 pts.
VK8KK—D. A. McAuthur	439 pts.
VK9XI—Christmas Is. A.R.C.	132 pts.

Phone Section

VK1AU—C. Harvey	710 pts.
VK2RS—D. Haberecht	856 pts.
VK3MO—I. Williams	1065 pts.
VK4PQ—N. Martin	783 pts.
VK5BQ—B. Cleworth	741 pts.
VK6RY—R. Chamberlain	759 pts.
VK7MS—D. Slowan	740 pts.
VK8DI—B. Burns	102 pts.
VK9AG—A. Nunn	354 pts.
VK0KH—K. Hicks	414 pts.

C. W. Section

VK2VN—M. Myers	507 pts.
VK3XB—I. Stafford	436 pts.
VK4HH—H. Hilder	258 pts.
VK5MY—H. Roberts	411 pts.
VK6WT—D. Couch	380 pts.
VK7SM—S. G. Moore	440 pts.
VK8UX—L. W. Wallbridge	17 pts.
VK9CJ—C. Marley	133 pts.

VHF - UHF Section

VK2ZCF—R. Norman	90 pts.
VK3ZNJ—K. Jewell	73 pts.
VK4ZLO—L. Davies	16 pts.
VK4ZPL—P. Lindsay	16 pts.
VK5ZTM—T. Marshall	56 pts.
VK6HK—D. Graham	21 pts.
VK7ZAC—G. C. D'Emden	10 pts.
VK8ZJG—J. Grace	10 pts.

Receiving Section

L2188—C. Christiansen	806 pts.
L3100/P—S. W. L. Group VK3	715 pts.
L4152—D. Hunter	571 pts.
L5065—A. F. Raftery	817 pts.
L6021—P. Drew	925 pts.
S.W.L.—G. Johnston	1011 pts.
L9004—J. Corvan	193 pts.

Interest was added to the 1965 R.D. Contest by the inclusion of a VHF section, thus enabling the holders of Limited Licences to take a more active part.

It would appear from the results that the percentage of logs received from Limited Licencees compared favourably with those submitted for the other sections of the contest.

Proposals which will enable the full participation of Limited Licencees in the contest will probably be discussed at the Federal Convention at Easter, in Brisbane.

HAM RADIO SUPPLIERS

5A MELVILLE STREET, HAWTHORN, VICTORIA

Phone 86-6465 **ESTABLISHED 1947**

SINCLAIR X-20

INTEGRATED 20 WATT PULSE WIDTH MODULATED AMPLIFIER AND PRE-AMP

A new concept in high fidelity performance

The use of P.W.M. assures a far better transient response than is possible with other amplifiers and this adds greatly to the quality of reproduction from the speaker.

Harmonic distortion is so low as to be hardly measurable, let alone audible, and cross-over distortion, which can cause such marked unpleasant effects in conventional transistor amplifiers, simply cannot occur at all in the X-20.

Number of transistors: 12
Overall size: 8¼in x 3¼in x1in.
Weight: 4½oz.
Input sensitivity: 1mV into 5kQ.
Total harmonic distortion: Less than 0.1% at 10 W.

Output power into 7.5 or 8 ohm speaker:
20 watts R.M.S. music power.
15 watts R.M.S. continuous.

Output power into 15 ohm speaker:
15 watts R.M.S. music power.
12 watts R.M.S. continuous.

These output ratings are quoted to the standard British method of rating. Using the method usually employed in the U.S.A., these ratings would be doubled, giving, for example, 40 watts music power into a 7.5 ohm speaker.

Frequency response at all power levels: 20 c s to 20 kc s plus 1 db
Damping factor: Greater than 100.
Quiescent consumption: About 150 mA.
Supply voltage: 28 to 37 volts (7.5Q speaker). 28 to 45 volts (15Q speaker).
Signal to noise ratio: Better than 70 dB.
Pulse repetition frequency: 65 to 75 kc s.

Enegy conversion factor at output at least 95% efficient.

A filter is built into the output of the X-20 so that it may be used with any type of resistive or inductive load of the correct impedance.

X-20 AMPLIFIER

Completely Built and Tested.

Price £16/15/- $33.50

SINCLAIR X-20 AMPLIFIER

Complete Kit of Parts
with instructions for assembly.

Price £13/7/6. $26.75 inc, tax

X-20 A.C. MAINS POWER

Supply (200-240 volts).
Suitable for driving up to
2 x-20 Units.

Price £7/17/6. $15.75 inc. tax

12-VOLT TRANSISTORISED POWER SUPPLY

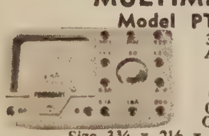
Q Plus type TPS50/12.
INPUT: 12 volts DC.
OUTPUT: 300 and 150 volt DC 50 watts continuous operation.
FREQ.: 1200 c/s approx.
As-new condition.

Price £11/10/-. $23.00

Post extra.

FERROCART POCKET MULTIMETER

Model PT34



300 uA movement.
AC and DC voltages: 0-10, 0-50, 0-250, 0-500, 0-1,000c.
Current ranges (mA) 0-1, 0-100, 0-500 mA.
Ohms range: 0-100,000
Size 3¾ x 2½ x 1¼ inches.

Price 57/6. $5.75

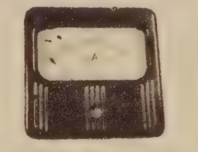
Complete with leads.

TV BALLUN

ABL 300 Ohm TV Ballun $1.75 (17/6)

FILAMENT TRANSFORMERS

T 4/4 230v.-6.3v 2 amp $3.25 (32/6)
2150 240v.-6.3v-2.5A or 2 x 6.3-1.25A, $3.50 (35/)
2155 240v-6.3v, 7.5, 8.5, 9.5, 12.5, 15v lamp $4.60 (46/)
12/64 240v 6 volt 4 amp-12 volt 4 amp $5 (50/)
12/66 240v 6 volt 6 amp-12 volt 6 amp, $5.75 (57/6)



PLASTIC PANEL METERS

P22 2in square. Clear Plastic Case, 1¾in round mounting hole; 1¼in deep.
P22 500 uA $4.00 40/ P22 1 Ma. $3.75 37/6
P25 2¼in square. Clear Plastic Case, 2⅛in round mounting hole, ¾in deep.

P25 50 uA $8.25 82/6	P25 50 Ma. $4.75 47/6
P25 100 uA $7.25 72/6	P25 100 Ma. $4.75 47/6
P25 500 uA $5.50 55/	P25 16 volt D.C. .. $4.75 47/6
P25 1 Ma. $4.75 47/6	P25 300v AC $4.75 47/6
P25 5 Ma. $4.75 47/6	P25 S Meter $5 50/
P25 10 Ma. $4.75 47/6	P25 VU Met $7.50 75/
P25 20 Ma. $4.75 47/6	

MR1P 1¼in square. Clear Plastic. 1in round mounting hole; 1¼in deep.
MR1P 1 Ma. $3.25 (32/6)
MR1P 500 uA $3.50 (35/)

MR2P 1¾in square. Clear Plastic. 1½in round mounting hole; 1½in deep.
MR2P 50 uA $5.50 (55/)
MR2P 50-0-50 uA. $5.50 (55/)
MR2P 100 uA. $4.75 (47/6)
MR2P 500 uA. $3.75 (37/6)
MR2P 1 Ma., 5 Ma., 10 Ma., 15 Ma., 20 Ma., 25 Ma., 50 Ma., 100 Ma., 250 Ma., ALL .. .. Each $3.50 (35/)
MR2P 15 amp D.C. $3.50 (35/)
MR2P 15 Volt D.C. $3.75 (37/6)
MR2P VU Meter $4.50 (45/)
MR2P Stereo Balance $4.25 (42/6)
MR2P 300-30 amp D.C. .. $4.25 (43/6)
MR2P "S" Meter $3.75 (37/6)
(S Meter reads S1 to S9 plus 10 to 30db FSD 1 Ma.)
MR2P 300 volt AC $4.25 (42/6)

MR3P 3 x 3⅜in square Clear Plastic, 2¾in round mounting hole, 1½in deep.
MR3P 50-0-50 uA $8.25 (£4/2/6)
MR3P 50 uA $7.25 (£3/12/6)
MR3P 500 uA. $5.75 (£2/17/6)
MR3P 1 Ma. $5 (£2/10/)
MR3P 5 Ma., 10 Ma., 25 Ma., 50 Ma., 100 Ma., 250 Ma., 500 Ma., ALL .. .. Each $5 (50/)
MR3P VU Meter $7.75 (£3/17/6)
MR3P 300 Volt A.C. .. $5 (£2/10/)

MR52 2½in square, Black Plastic, 2in round mounting hole, 1¼in deep.
MR.52 100 uA $6.25 (62/6)
MR52 500 uA $4.75 (47/6)
MR52 1 Ma., 5 Ma., 10 Ma., 25 Ma., 50 Ma., 100 Ma., 250 Ma., 500 Ma., ALL .. .. Each $4 (£2)

MO52 2⅝in round face, 2½in hole, Black Plastic Case.
MO52 500 uA $3.85 (38/6)
MO52 1 Ma. $3.65 (36/6)

EW-20 Edgewise Meter 2¼ x ¾in rectangular Clear Plastic Case, 2in deep.
EW-20 1 Ma. $4.25 (42/6)

EW16 Edgewise Panel Meter 1 x 3¼in face, 3½in deep.
EW16 500 uA $7.75 (£3/17/6)
EW16 1 Ma. $6.75 (£3/ 7/6)
EW16 300 volt A.C. .. $7.75 (£3/17/6)

MR65 3¼in square face, 2½in round hole. Black Plastic Case.
MR65 500 uA. $5.25 (52/6)
MR65 1 Ma., 5 Ma., 10 Ma., 25 Ma., 50 Ma., 100 Ma., 250 Ma., 500 Ma., ALL .. .. Each $5 (50/)
MR65 50 Volt A.C. $4.75 (47/6)
MR65 VU Meter $8.25 (£4/2/6)

MO65 3¼in round, 2½in round hole, 1½in deep. Black Plastic.
MO65 100 uA $5.50 (55/)
MO65 500 uA. $3.75 (37/6)
MO65 1 Ma., 5 Ma., 10 Ma., 20 Ma., 50 Ma., 100 Ma., 150 Ma., 250 Ma., 500 Ma., ALL each $3.50 (35/)
MO65 50 Millivolt $3.75 (37/6)
MO65 100 Millivolt $3.75 (37/6)
MO65 15 volt D.C. $3.50 (35/)
MO65 30 volt D.C. $3.50 (35/)
MO65 300 volt D.C. $4.25 (42/6)
MO65 300 volt A.C. $4.25 (42/6)
MO65 1 amp. D.C. $3.50 (35/)
MO65 30-0-30 D.C. amp. . $4.25 (42/6)

"VU" METERS

Scale: —20—0 +3 VU.
0-100% (OVU) at 600 ohm.
Frequency Range: 30-7500 C/S.
Impedance eq. 3900 plus minus 200 ohms.
Time Constant: eq. 0.3 sec.
(Time for 99% response.)
MR2P VU Meter $4.50 (45/)
MR3P VU Meter $7.75 (£3/17/6)
MR65 VU Meter $8.25 (£4/2/6)
MR4P VU Meter $10.50 (£5/5/)
MR4P 1in x 4½in square, 2¾in round hole clear plastic case:
MR4P 1 Ma. $6.50 (£3/5/)
MR4P VU Meter .. .. .. $10.50(£5/5/)

ELECTROLYTIC CAPACITORS

Brand new Sub-miniature & Pigtail, PVC sleeved

Mfd.	Volts	Price	Mfd.	Volts	Price
2	12	30c (3/)	30	12	32c (3/3
4	3	30c (3/)	30	6	30c (3/
5	6	30c (3/)	32	350	50c (5/
5	12.	30c (3/)	50	6	30c (3/
5	18	35c (3/6)	50	12	35c (3/6
8	10	30c (3/)	50	25	45c (4/6
8	15	30c (3/)	64	6	32v (3/3
8	300	48c (4/9)	64	18	32c (3/3
8	600p	58c (5/9)	100	6	32c (3/3
10	3	30c (3/)	100	12	37c (3/8)
10	6	30c (3/)	100	25	50c (5/)
10	12	30c (3/)	100	350	$1.50 (15/
10	25	32c (3/3)	250	3	50c (5/
16	10	32c (3/3)	250	16	50c (5/3
16	300	52c (5/3)	250	50	90c (9/
15	600p	70c (7/)	500	12	50c (5/
24	350	70c (7/)	500	50	$1.30 (13/
24	500	75c (7/6)	1000	6	82c (8/3
25	3	30c (3/)	1000	12	98c (9/9
25	6	32c (3/3)	1000	18	$1.15 (11/6
25	12	30c (3/)	1000	25	$1.32 (13/3
25	25	35c (3/6)	50plus50	350	$1.60(16/
25	50	42c (4/3)	(can type)		

VERNIER DIALS

Ratio 8 to 1, reduction, scaled 0-10.
Type T501, 1½in diam. $1.75 (17/6
Type T502, 2in diam. $2.20 (22/
Type T503, 3in diam. $2.80 (28/

TRANSISTOR INTERCOM UNITS

4 Station; 1 master 3 sub-stations 3 Transistor 250mW, Amplifier, Battery operated (Ever ready 216), complete with Battery, Wire Staples and fitting instructions $20.50 (£10/5/
Also 2 Station Model $13 (£6/10/

TRANSISTORISED 40 WATT STEREO AMPLIFIER

Fully Transistorised 20 watts per channel.

Freq. response	20-20,000 c/s 1db.
Inputs	Magnetic P.U., tape hea Xtal P.U., tuner and aux.
Controllers	Volume, treble, bass, balanc controls.
Switches	Scratch filter, rumble filter loudness control, speake phase, tape mon., AC, DC OFF.
Complement	22 transistors, 2 diodes, thermistors.
Voice coil imp.	4-16 ohm (8 ohm standard)
Output power	Undistorted 15W x 15W. Maximum 20W x 20W.
Voltage	AC 115 or 230V, DC 24 o 36V.
Distortion	Less than 0.1% at 10W pe channel.

Price £55. $110.00 inc. tax

TAXI RADIOS

Pye MK1 Reporter Transceivers Ex-Taxi. Approx. 70-80 M/C AM Crystal Locked, complete with valves less crystal, ideal for conversion to AM Net 52 M/C. GOOD CONDITION $30 (£15

ALIGNMENT TOOLS

Jabel No. 4 Alignment Tool Kits. All popula sizes, 4 Tools in Plastic Pouch .. $1.20 (12/

TRANSISTOR RADIO

6 TRANSISTOR POCKET RADIO

Complete with Earphone, Leather Case and Battery. 2½in Speaker.

£9/10/. $19.00 inc. tax

ching profession, but this will no doubt welcomed by the Blue Mountains Branch.

Club members presented Don and his e Barbara with a wall clock as a token their appreciation for all the work they d done for the club.

After a recess during the holiday period club will hold the first meeting for 66 on Friday February 4th and then every iday night.

Meetings are held 10 Gideon Street, rrandera, commencing at 7.30 p.m.

A welcome awaits amateurs who may travelling through the Riverina in New uth Wales and pay a visit to a meeting the club. A note to the Secretary, C/- East Street, will obtain all details of Club's activities.

SOUTH AUSTRALIA

In the December issue of the Journal the South Australian Division, the resigtion of John Haseldine, VK5JC, from uncil was recorded. John also relinquishhis positions as Secretary of the Division, d W.I.C.E.N. Co-ordinator.

Ross Dow, VK5KF, President of the vision, on behalf of the Council and mbers generally, expressed sincere appretion for the time and effort John had voted over a period of many years, to benefit of the Division.

Al Rechner, VK5EK, was appointed to the vacancy on Council and will take er the onerous duties of Divisional Secrey.

Geoff Taylor, VK5TY, has taken over task of W.I.C.E.N. Co-ordinator and orts that there are 20 mobile stations w operational on the 53.1MC net freency and up to four base stations. Field ts are also being carried out on the -metre band with the view of using this a link between Adelaide and VHF biles in the field.

The Bill for the Licensing of Electrical orkers and Contractors has had the attenn of members of Council and, in an deavour to clarify the proposals as far the Act would affect licensed amateurs, views of the Division were circulated all Members of Parliament.

In addition, a deputation appointed by Council met and personally explained suggestions for amendments to the Bill. embers of the deputation were: Keith ng, VK5KH; Comps Daw, VK5EF, and arwick Parsons, VK5PS.

WEST AUSTRALIA

A new venue for the general meetings the West Australian Division has been nounced.

Divisional meetings will in future be held the Forrest Park Methodist Church Hall, cated on the corner of Walcott and Cur- Streets, Mount Lawley. The hall is xt to Forrest High School and close to Police Radio Station.

Good progress is being made in organig an active W.I.C.E.N. Group. Each nday morning at 10.15am W.A.S.T. calls ll be taken from W.I.C.E.N. units by Division's Co-ordinator Brian Pemberh, VK6VW. Frequencies to be used are .656MC FM (Channel B) and 3.590MC M or SSB. Calls from mobile units will taken first, followed by base stations.

In the near future calls will also be ken on two other frequencies, namely 5MC AM and 52.2MC AM.

The organisers point out that responbility for emergency communication can ly be accepted in proportion to the operars who are willing to make themselves d equipment available.

To up-date the records so that the ext of equipment now available can be adily determined, persons interested are vited to forward to the Secretary, Box 1002, G.P.O., Perth, details of their base tion, portable and mobile equipment, tother with name, address, phone number d during which periods they would be ailable in the case of an emergency curring.

The lack of equipment, or even a call sign should not be a deterrent to offering assistance to the W.I.C.E.N. Group, as in an emergency capable assistants are very valuable.

VHF GROUP

Visitors are very welcome to the meetings of the VHF Group held on the fourth Friday in each month in the D.C.A. Workshop Canteen, 86 Guilford Road, Maylands, at 8 p.m.

A rather interesting and unusual par appeared in a recent issue of the West Australian VHF Group News Bulletin:

"Help is wanted by the University Zoology Department in the form of "fox" hunting. They desire to locate tortoises by a Direction Finding technique. The animals carry 27MC transmitters. Present aerials (a simple loop) are not sensitive enough. Any member with suggestions should contact Mr Burbidge of the Zoology Department."

Three beacons are now in operation with the Club station call sign VK6VF. The frequences used are 52.006MC; 144.067MC and 432.2MC. The beacons may be identified by the automatic CW signal giving the call VK6VF with an approximate foursecond key down period between call signs.

Reports on the reception of these beacon signals will be appreciated by group members.

TASMANIA

To assist the holders of Limited Licences and others interested in learning the Morse Code, it is proposed to commence Slow Morse Transmissions on a frequency of 52.2MC.

The sessions will commence at 2000 hours (8pm) on Sundays, Tuesdays and Thursday evenings.

Commencement date will be given over the Division News Broadcast from VK7WI on Sunday mornings at 1000 hours (10 a.m.)

Acknowledgement will be appreciated at the end of each session from those making use of this service.

BRITISH EXHIBITION

In a recent edition of the English newspaper, "Electronics Weekly," Pat Hawker, a very well-known communications correspondent and editor of a new RSGB publication "Technical Topics for the Radio Amateur" (a series which has been running since 1958 in the Society's journal) made some interesting observations on an exhibition held recently.

"At one time an amateur radio station could be visualised as a room crammed with racks of equipment. Today, as the 1965 RSGB International Radio Communications Exhibition emphasised, a complete station can fit easily on a small table or in a car, and still leave plenty of room.

"Award for the best home-constructed equipment — in a record entry — went to a schoolmaster, Mr E. Sydenham (G3LOK), for a beautifully made mobile solid state equipment. The Horace Freeman award went to Mr J. J. Pink (G3OQB) for a 1296MC converter and a regional award was won by Mr R. C. Marshall (G3SBA) for a compact SSB transceiver. There were many other kitchen-table units worthy of admiration.

"In this connection, SSB transmitters being made in Wirral by a constructional group, organised at a local evening institute, illustrated well the educational value of group projects.

"More than 17 high-quality SSB transmitters are being made at a cost to the individual member of less than £40, made possible by the use of group test equipment.

"Manufacturer's Award for new commercial equipment went for the second year running to T. Withers (Electronics), of Enfield, for their new solidstate variable frequency oscillator intended for use with 144-MC transmitters and with the fundamental oscillator on about 6MC. Even thumping the stand made little difference to the note.

"New solidstate units, including some very compact UHF converters, on the Green Electronic and Communication Equipment stand also caught the eye.

"On the British Amateur TV Club stand was John Ware's (G6RSA/T) 150-watt 70-M TV transmitter with a three-inch image orthicon camera channel by Terry Lane, set up for the live TV link with the TV Society's meeting last Friday. Particularly active in the London area are G6OUO/T, OUH, PJE, NDT, OPB, AAQ and RSA, mostly pumping out 405-line transmissions in the 70M band.

"Ignition interference suppression was featured by the Mobile Amateur Radio Society.

"For those faced with the problems of learning Morse, gramophone records for this purpose were demonstrated on the RSGB stand. Those already qualified were challenged to prove their skill on the Royal Navy stand."

At the opening of the Exhibition, Mr D. A. Barron, G.P.O. engineer-in-chief, emphasised the value of continuous liaison between professionals and amateurs in radio. "It is fair to say that major projects owe something to this type of collaboration. Professional-amateur tie-up is always useful in the radio field," he said.

TERMINOLOGY

A far-reaching change is to be made to the American usage of the time-honoured terminology "Cycles per Second" (Cps).

The American Bureau of Standards has decreed that, in future, due to the widespread international usage, the term "Hertz" will replace "Cycles per Second."

This change will mean that Cps will become Hz, Mc will be MHz and Gc will be GHz.

The reason given for the change is that it is one more step towards a truly international technical language.

Will the time-honoured Amateur Band references 7; 14 or 144 Megs become 7; 14 or 144 Mertz — what do you think?

YOUTH RADIO SCHEME

With the school holidays in progress at the time of compiling these notes, only a limited amountof news was to hand. However, the final comments from those associated with the scheme, for 1965, leaves no room for doubting that progress will be even greater in 1966.

VICTORIA

At the end of the exams for the Elementary Certificate, three school clubs, Macleod Radio Club; Geelong East Technical School, and Essendon Grammar, each had 11 members gain satisfactory passes.

The first Victorian non club member, Peter Cole, of Balwyn, also gained the Elementary Certificate. Peter is a student at the Camberwell Grammar School.

NEW SOUTH WALES

Elementary Certificates were awarded to nine students of the Kiama High School; three at Birrong Boy's High School; six at Westlakes Radio Club; 14 from Waverley College; three members of the North Strathfield Boy Scout Radio Club, and a Post Group member, Geoffrey Puleston, who attends the Picnic Point High School.

Prizes donated by the Overseas Telecommunications Commission to Elementary Certificate holders who gained over 90 per cent in the written examination were:

Ross Steel (Lyneham High School)	99 p.c.
David Truskett (Kiama High School)	97 p.c.
Stephan Ford (K'grove North High)	97 p.c.
Gregory Crease (K'grove North High)	97 p.c.
Jeffrey Tan (Waverley College)	95 p.c.

A donation of five pounds worth of books on electronics has been made to the Youth Radio Scheme as prizes for N.S.W. students, by Mr John Westmore, of Roselands Book Centre.

This fine gesture coincided with the opening of Australia's largest and most modern shopping centre. ◼

A. AMPLIFICATION
C. COMMUNICATION
E. ELECTRONICS

★★★★★★★★★★★★★★★★★★★★★★PHONE 51-384

RADIO

636 KING STREET, NEWTOWN—51-7008

136 VICTORIA ROAD, MARRICKVILLE — 51-3845

PLAYMASTER 2 STEREO AMPLIFIERS

Push-Pull. 8 Watt per Channel Bass and Treble boost and Cut. Wired and Tested.

£31

Buyers please note: Due to component and production cost increases we regret the price of P.A. Amplifiers, Guitar Amps. and Stereo Amps. wi.l be increased in the near future.

GUITAR AMPLIFIERS

10-Watt. Two Channel, with Twin Cone Speaker. £25/15/-.

14-Watt. 4 Inputs. Bass and Treble Boost. 2 Twin Cone Speakers. £29/15/-.

17-Watt. Four-Channel. Bass and Treble Boost. Two Twin Cone Speakers. £36/17/6.

35 WATT

4-Channel. Bass and Treble Boost. 4 Twin-Cone Speakers .. £52/10/-

60-Watt, 2 Unit

4-12in Auditorium Speakers.

£85/17/6

Vibrato with foot control and 2 pre-set controls for frequency and intensity. £5/5/- extra on above models.

14 plus 14 WATT

With Reverberation. May be used as 28 Watt or as 14 Watt plus 14 Watt Reverb. 2 9 x 6 Woofer Speakers. 2 9 x 6 Twin-Cone Speakers. 4 Channels. Bass and Treble Boost. Foot Vibrato Control included.

£81/15/-

SLAP BASS OR BASS GUITAR 40 WATT AMPLIFIER

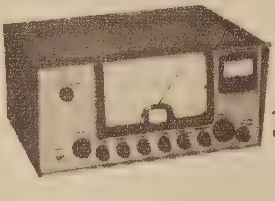
4 Input Channels. Bass and Treble Boost. 2 12in Radial Beam Speakers. Perfect reproduction on 20 cycles.

£72/17/6

PIGGY BACK GUITAR AMPLIFIER

30 Watt	£39	17	6
45 Watt	£49	17	6
60 Watt	£59	17	6

4 Inputs. Bass and Treble Boost. Vibrato if required. £5/5/ extra.



£72/10/-

1965 COMMUNICATIONS 8

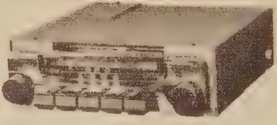
R. TV and H., January

This outstanding receiver for Ham or General use.

Wired — Tested Guaranteed

With mechanical filter.

£20 Extra



TRANSISTOR CAR RADIO

Push-button operation. High sensitivity. Tailored to fit most modern cars. 6v or 12v operation — state voltage. Polarity and speaker size.

£29 Complete

NEW RECORDING TAPE

5¾" 850ft	1	2	6
3in Mylar L.P. 300ft		10	6
5¾in Mylar L.P. 1150ft ..	1	7	6
5¾in Mylar D.P. 1650ft ..	1	17	6
7in P.V.C. 1200ft	1	5	0
7in Mylar L.P. 1800ft ..	1	17	6
7in Mylar D.P. 2400ft	2	15	0
10½in Mylar L.P. 3500ft ..	4	15	0

Post 2/6 per Spool.

P.A. SPEAKERS

8 WATT

8in Units in Waterproof Projection Horns. 15 Ohm Voice Coils.

£6/15/-

In Double Ended Flares. Duolateral Coverage.

£7/5/-

Line Output Transformers to suit, 17/6 extra.

P.A. SPEAKER DRIVER UNITS

American Rating. 30 Watts. Voice Coil 16 ohm.

£10/15/-

15 Watt Rating.

£7/17/6

REFLEX HORNS TO SUIT.

£10/15/-

WEEKEND — HOLIDAY — EVENING DEMONSTRATIONS AT COLLAROY

PHONE XW5956 FOR APPOINTMENT TO TEST STEREO GUITAR AMPLIFIERS AND TELEVISION.

BATTERY CHARGER

240 Volt A.C. Operation

3 Rate 6V, 12V TRICKLE CHARGE

Trickle Charge Position suits all Batteries. 2V to 12V at rate of 200 to 500 M.A.

STANDARD	
2 amp. 6V, 12V, TRC	£5/15/-
3 amp. 6V, 12V, TRC	£6/12/6
4 amp. 6V, 12V, TRC	£7/12/6
5 amp. 6V, 12V	£7/19/6

Post., N.S.W. 7/6, Interstate 12/6.

DE LUXE	
1½ amp., 6v-12v	£4/17/6
3 amp.	£8/7/6
4 amp.	£9/17/6
6 amp.	£10/17/6
10 amp.	£13/17/6

Rail or Air Freight on.

Cabinet only £5/15/. Cross-over unit £1/12/6.

PLAYMASTER BOOK SHELF UNIT

To R, TV & H specifications. Mountain Ash, Maple or Walnut finish.

Complete £14/5/

Also to suit, 8 W.R. and new Magnavox HF5SIC Tweeter.

£14/5/-

REVERBERATION UNITS

Latest design to suit orga stereo, guitar, any hi-fi equ ment.

£2-17-6 each

Post. 3/6.

ELEGA REVERB. SPEAKERS

Automatic addition of verberation to any existi amplifier. Handles 12 watts.

£12-15-0

CO-AXIAL SPEAKEF

C.S-30. 12"

V.C. 16 ohm. Cross over 3, cycle. Frequency range 30 20,000 cycles. Rated 20 wat

£13/19/6

C.S-20. 8"

V.C. 16 ohm. Cross ove 3,000 cycle. Frequency Range 40 to 20,000 cycle Rated 8 watts.

£7/19/6

HORN TWEETER CT-3

2,000-20,000 Response 20 Watts Power. Sensitivity 110 dbw. Weight 1¾lb.

£4-9-6

MULLARD-A.C.E. TACHOMETER

Wired and tested.

£10/7/6

"Electronics Australia", August issue. State max. revs., age, polarity cylinders.

METER ONLY

£3-7-6

INCLUDING DWELL. AN FACILITY.

£11/12/6

Post.: N.S.W., 5/; Interstate,

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RADIO

636 KING STREET, NEWTOWN—51-7008

136 VICTORIA ROAD, MARRICKVILLE — 51-3845

B.S.R.

4 TRACK DECK

£17/15/-

2 Track, 3 Speed.

£17/15/-

Track, 3 Speed. Mono or Stereo.

£22/12/6

4-TRACK. 3-SPEED.
3 HEADS.

£24/15/0

BRADMATIC HEADS
Latest ½ Track. Hi Fi.

£4/15/- Pair

HE NEW COLLARO TAPE DECK

Takes 7in spool.
3 speeds 1⅞, 3¾, 7½ i.p.s.
2 track £22.
4 track £24.
Write for particulars.

RANSISTOR POWER SUPPLIES

v. D.C. Input. 300v. 150Ma.
Output plus 150v. Output.

£11/17/6

v. D.C. Input. 400v. 150Ma.
Output plus 200v. Output.

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VARY. A.C.S.

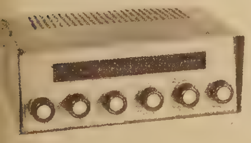
240-270V 50 cycle 5 amp.
ovide infinitely variable AC voltage.

£14/15/-

2½ Amp as above

£11/15/-

PLAYMASTER 106 AND 107



Feb. and March R. TV & H.

106
WIRED AND TESTED. **£42**

107
IRED AND ESTED. **£39/10/-**

ELECTRIC GUITAR

ckup Units	£4 7 6
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armonica Pickup Units	19 6

ost., N.S.W., 4/; Interstate, 7/6.

SPEAKER VENTED ENCLOSURES

Ith 8in Twin Cone Speakers itted, **£9/10/- Each**

ented Enclosures for 12in Speakers.
½ c. ft. **£11/15/-**

Transistor-Ignition HI-SPARK

Simple installation.
38 K.V. output.
Complete. Tested.
Negative earth.

£16/15/0

Positive earth.

£20/15/0

State voltage and polarity.
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CITIZENS BAND

27.240 Meg Fonet 102B
10 Transistor Transceivers.
Hi-Power. 240 MW.
Range to 10 miles.

£27/10/- each

BELCON

1 watt. 15 transistor, with squelch provision for two channels. Range to 60 miles under ideal conditions.

£40 each

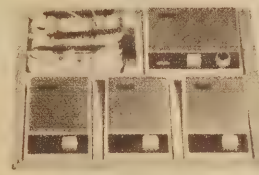
INTER. COM. UNITS

2 Station Transistorised

£5/15/-

4 Station including Master

£10/2/6



New Telephone Amplifier

Transistorised.

£5/15/-

Post 3/6.

T.V. TUNERS

New 10-channel Tuners.

£7/10/-

Post 7/6.

LATEST 4-SPEED PLAYERS

240V A.C. Mono	£5 15 0
240V A.C. Stereo	8 10 0
Battery Mono	9 15 0
Battery Stereo	10 15 0
Battery Mono 45 r.p.m. in Cabinet	4 12 6

Post. N.S.W. 7/6, Interstate 12/6.

Send for full details on Radiogram Chassis, TV and Amplifiers.

AMPLIFIERS

Public Address Range
240V-AC

MINIATURE P.A. AMPLIFIER.
15 WATTS OUTPUT.

Multimach Ferguson O.P. transformer input for crystal mike and pick-up with electronic mixing. P.P. EL.84 output.	£17/15/-
30 Watt. As above EL34 P.P.	£25/15/-
40 Watt. As above EL34 P.P.	£37/15/-
60 Watt. As above EL34 P.P.	£42/15/-
100 Watt. As above KT88 P.P.	£63/17/6

LINE OR VOICE COIL TRANSFORMERS.
MULLARD HI-FI RANGE.

5/10 with pre amp base and treble boost. Ultra Linear output	£21/15/-
5/20. As above	£32/15/-

BATTERY-AC OPERATION

6 valve 6v plus 240v-10 watt	£27/15/-
7 Valve 12v plus 240v-12 watt	£29/17/6
7 Valve 12v plus 240v-25 watt	£35/17/6

TRANSISTOR P.A. AMPLIFIER C.A.-512

12VDC Operation
Output 20 watts
Current consumption at max. output. 2.2 amps.
Input. High imp. mic. Also 600 ohms and tape.
Independent gain controls.
Output: Imp. 4-8-16 ohms.
Freq. Response:
200 cps—6000 cps
Dimensions 2in x 6¼in x 8½in.
Complete with instruction book with circuit. All plugs.

PRICE £28/15/-

DYNAMIC MICROPHONES

DM -391 Hi-Imp	£1 15 0
DM -175 Hi-Imp	£2 7 6
DMS-3 Hi-Imp	£2 15 0
DM -305. 600 ohms or Hi-Imp. Suitable stand mounting ..	£4 17 6
DM-304. Dynamic Cardioid. 50 ohms or Hi-Imp. Suitable stand mounting ..	£7 17 6
CM -10 Crystal Hi-Imp Suit. stand mount.	£2 10 0

Post N.S.W. 2/6; Interstate 3/6.

WIDE RANGE LIGHTWEIGHT STEREO PICK-UPS

Ceramic Units. Sapphire Styli	£3 10 0
Diamond Styli	£5 5 0
Universal Ceramic Stereo Cartridge, Sapphire. Styli	£1 9 6
Diamond Styli	£3 5 0

NEW WIDE RANGE SPEAKERS

15 ohm. Twin Cone

8in	3 10 0
12in	3 19 6
5in	2 5 0
5in Tweeter	1 17 6
4in Single Tweeter	1 7 6
12in Heavy Duty 20 watt	£7/15/

P.A. REFLEX HORNS

WITH UNITS

5 Watt 8 ohm	7 5 0
10 Watt 8 ohm	13 5 0
35 Watt 15 ohm	18 0 0

N.B.: As these are American ratings, divide the wattage by 2.

STEREO RECORD CHANGERS

1965 model. 4-speed.

£10/15/

De Luxe Model.
Fully machined and balanced. Heavyweight turntable. Ceramic cartridge.

£13/15/

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STEREOPHONIC HI-FI HEADPHONES

With padded earpieces
SPECIFICATION . . . .
Frequency Response 25—17000 cps.
Nominal Power 1 watt.
V.C. Imp. 8 ohms each channel.

£3/17/6 Post 5/.

PHILIPS DISC JOCKEY

4-Speed Players.
6V. D.C. OPERATION.
MONAURAL CRYSTAL HEAD

£4/17/6

STEREO.

£5/17/6

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MORSE KEYS

New lightweight, fully adjustable units

9/6

As above with buzzer.
Complete Morse practice set.

16/6

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A. C. E.

AMPLIFICATION

COMMUNICATION

ELECTRONICS

RADIO

136 VICTORIA ROAD, MARRICKVILLE, SYDNEY,
AND 636 KING STREET, NEWTOWN—51-7008

K 20 CT330

K 20 CT500

220S 4000 O.P.V.

D.C. Volts 5, 25, 125, 500, 2500. A.C. Volts 10, 50, 250, 1000. Current. 250uA. 250mA. Resistance 0-10K, 0.1 Meg.

£3/19/6 Post 5/-

C.T.330 20K.OPV

D.C. Volts, .6, 6, 30, 120, 600, 1200 3000, 6000 A.C. Volts, 6, 30, 120, 600, 1200, D.C. Current, .06-6, 60, 600mA. Resistance, 6K, 600K, 6meg., 60meg. D.B. minus 20 to plus 62. 5 Ranges. Specially suitable for transistor use. **£7/19/6** Post 5/.

C.T.500 20K.OPV

D.C. Volts, 2.5, 10, 50, 250, 500, 1000, A.C. Volts, 10, 50, 250, 500 1000. D.C. Current, .05, 5.50 500mA. Resistance, 12K, 120K, 1.2meg., 12meg. D.B. minus 20 to plus 62.

£6/12/6 Post 5/.

S.E.550 100K.OPV

D.C. Volts, .5, 2.5, 10, 50, 250, 500 1000. A.C. Volts, 2.5, 10, 50, 250 1000 D.C. Current. 10uA, 2.5, 25, 250mA, 10 amps. Resistance, 2K 200K, 2M, 20M. D.B. minus 20 to plus 62.

£10/7/6 Post, 7/6.

P.T.34 1000.OPV

D.C. Volts. 0, 10 50, 250, 500, 1,000.
A.C. Volts. 0, 10, 50, 250, 500, 1,000.
M.A. 1-100-500 RESISTANCE.

£2/12/6 Post 5/.

200H. 20K.OPV

D.C. Volts, 5, 25, 50, 250, 500, 2500. A.C. Volts, 10, 50, 100, 500, 1000. D.C. Current. 50uA, 2.5, 250mA. Resistance, 6K, 600K. Capacitance. 2 D.B. Ranges.

£5/5/- Post, 5/.

ALL PRICES NET, INC. S./TAX.

V.T.V.M.

27 Ranges A.C. Powered.
D.C.V. 0, 1.5, 5, 15, 50, 150, 500, 1,500.
A.C.V. 0, 1.5, 5, 15, 50, 150, 500, 1,500 R.M.S.
A.C.V. P. to P. 0, 1.4, 4, 14, 40, 140, 400, 1,400, 4,000.
Resistance 1 ohm to 1,000 megohm.
D.B. — 10 D.B. to + 65 D.B.

£21/5/-

Post 10/.

H.V. Probe to 30 KV, £4/2/6.
T.M.K. Units, £26/15/-

TEST EQUIPMENT

WIDE BAND OSCILLOSCOPE

5 Meg. Bandwidth. Push-pull vertical and horizontal Amplifiers. 8 position, high sensitivity vertical Amplifier, Frequency Compensated on all positions. Calibrated .02 to 600 volt. Hard-time base, 20 cycles to 75K. Latest American R.C.A. circuitry. Complete with probe.

3-inch £49/17/6; 5-inch £55/15/-

MINILAB 7in 1 MULTIMETER

£8-7-6

Post 5/.

TRANSISTORISED VARIABLE POWER SUPPLY

Range to 20V, 200MA.

£9-7-6

Post 5/.

4 CHANNEL MICROPHONE MIXER PRE AMPLIFIER

£3-17-6

Post 5/.

STEREO PRE AMPLIFIER

Suit Tape, Magnetic heads, Microphones.

£5-15-0

Post 5/.

G.D.O. UNITS

Leader. 810. 6-Band. 2 Meg. to 260 Meg. Nuvis'orised. 240 V.A.C. Operation. Modulated. Calibration Accuracy 2 per cent.

£19/15/-

T.E. 18 Lafayette. 8 Bands, 360 K.C. to 260 Megs. 240 V.A.C. operation.

£19/15/-

Post N.S.W., 5/; Interstate, 7/6.

LEADER SWEEP & MARKER GENERATOR

TV and F.M. 2 to 270 Megs. 5.5 Meg. Crystal for TV sound. Sweep width to 12 Megs. Model 531.

£69-10-0

Model 532

£85-0-0

Post N.S.W., 15/; Interstae £1/5/.

PANEL METERS

EDGE TYPE

1 mA. Scaled. S. Meter. Stereo Balance. Tuning. **£1/5/-**

2" 3" 4" PLASTIC COVERED PANEL UNITS

Latest P series ¾in Barrel 50 mmA. 200 mmA. 1mA. 10 mA 500mA, 1 Amp, 10 Amp. 15V. 500V. **From £1/10/-**

T.E. 20 RF SIGNAL GENERATOR

Freq. 120KC—260MCS in 6 bands.
Output (RF)—High 100.000uV max. Low 100uV max.
Output (Audio)—400 cps approx. 8V.
Modulation — 400 cps internal.
Operation — 240V AC.
Dimensions 7in x 10½in x 5½in.
Weight — 9lb.
Complete with Instruction Book circuit.

£13/5/-

Post N.S.W. 7/6; Interstate 12/6.

LEADER SIGNAL GENERATOR LSG 11

240v A.C. Powered.
6 Band, 120 Kc to 390 Megs.
Provision for Crystal.
An Ideal TV Marker Generator.

£14/15/-

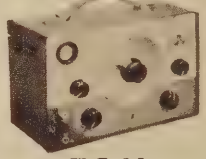
Post. N.S.W. 7/6, Interstate 12/6

SIGNAL INJECTOR

Transistorised, Fountain Pen size
Unit for Signal Tracer in Radio
TV and Amplifier Service.

£2/7/6

POST 2/6.



T.E.46 RESISTANCE-CAPACITANCE

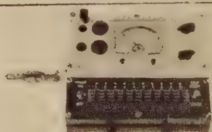
Bridge and Analyser
Capacity 20 pfd to 2,000 mfd.
Resistance 2 ohm to 200 megs.
Also tests power, factor, leakage
impedance, transformer ratio, insula
tion resistance
to 200 megs. at 600V.
Indications by eye and meter

£25/19/6

T.E.22 AUDIO GENERATOR

Sine and Square Wave.
20 Cycles to 200 KC. 4 Bands.
Frequency response plus/minus 1.5 D.B.
60 Cycles to 150 K.C.
Output impedance 5,000 ohm.
Output volts, 0 to 7.

£22/2/6



VALVE TESTER

Tests all valves, diodes, rectifier
checking filaments, shorts. Merit
direct reading. Good-bad mete
Complete with tube chart.

£13/7/6

Post. N.S.W. 7/6, Interstate 12

T.E. 50.—99—5011

Checks. Nu Vistas, Compactron etc.

£17-2-6

LISTENING AROUND THE WORLD

Art Cushen's monthly report on long-distance short-wave, television and broadcast band reception.

ıshen Broadcasts from Hilversum

One of the latest inovations in the Radio Nederlands DX Jukebox program is a Pacific DX report, which is recorded n Invercargill for broadcast by the Hilversum station in its English language transmissions.

E new feature, "Arthur Cushen's acific DX Report," will be broadcast 12 English language transmissions on rst Thursday of each month. As well e Hilversum transmissions, it will be d on the broadcast band and short from the relay station at Bonaire, in Netherlands Antilles, for Africa and merican continent.

e session will feature almost exclusively from the Pacific area, and will be ved on the second Thursday by the nd DX Report the third Thursday by J.S.A. DX Report, and on the fourth sday by the Benelux DX Report, giving ar listeners a wide variety of news e DX Juke Box session. This program for 30 minutes, and the DX information is only a part. The program includes , answers to technical questions, sun- and SW reception predictions, and a ical survey of new items on the et and news on electronics in general.

e program is heard on Thursday at GMT on 11970, 11730 and 9715KC. transmissions which should be heard le broadcasts at 1445GMT on 17810, ; 1915 on 9590, 6025; 2015 on 15220; on 9590, 6085 and 0145 on 9590KC.

RADIO FREE EUROPE

e highest frequency yet observed in 3M band is 21745KC now used by Free Europe in Munich, Germany, its transmissions to Eastern Europe. 00GMT a popular music program is and, with announcements, this con- to 1100GMT when news in Hun- n is carried. The station, which is ved at fair level, suffers some jamming g the newscast. The Radio Free pe organisation has its mailing address ne Radio Free Europe, Engineering ion, 2 Park Avenue, New York. Veri- on is now on a white card with green in bold lettering. The card states that has transmitters at Munich, Germany, Lisbon, Portugal, in the 75, 49, 41, 31, 9, 16 and 13M band, and on medium

is reception is also reported by Bob la, of Melbourne, Vic., who hears the opening on 21745KC at 0935 in . Another frequency, 21720KC, opens 35 in Polish.

VQ03-VQ04 SOLOMONS

ormation on the plans to erect a new na by the Solomon Island Broad- g Service, to improve reception on C for the area of the Island group een received from the station officials.

e stations now operating are VQ0 C 660W; VQ03 3205KC 500W and on 3995KC with 5KW. The stations n the air Monday to Friday 0725- Saturday 0755-1130 and Sunday 0825- On Monday the station has a service chools from 2245GMT Sunday. The evening program includes BBC news at 0915, and news from the ABC at 1100, while news in pidgin and shipping news is broadcast at 0745GMT.

The station reports that regular mail is received from New Zealand, Australia, Papua-New Guinea, and the New Hebrides. DX reports are received from Japan, United States, South America and even Europe at certain times. A new eight-element aerial is at present under construction, and is due to be put into service this month on VQ04. This will improve the local signal within a radius of 700 miles, probably at the expense of reception in New Zealand and other areas in the South Pacific. The SIBS intends to try to improve the signals in the area, according to Mr R. W. McLeish, Broadcasting Officer of the Solomon Island Broadcasting Service, P.O. Box 115, Honiara, Solomon Islands.

RADIO BERLIN INTERNATIONAL

The transmissions in English for the South Asia area from Radio Berlin International, East Germany, show some changes in the frequencies used, and Steve Thurlow, of Cabramatta, NSW, sends along the latest schedule. We have also had a request from the station for comment on the reception in this area. We find that frequencies which are being used are also used by more powerful stations, and the major cause of poor reception is poor frequency allocation, apparently due to assignment of channels by theory instead of in practical reception conditions. The 0730GMT service uses 15240KC, 19M band, which is too high for a good service in the summer months. Major European stations use 49, 41 and 31M for this transmission time. The service at 1200 and later gives much better reception, but is too late for an appreciable listening audience either in Australia or New Zealand.

The transmissions in English are:

0700-0730 on 15240; 1200-1300 on 15240; 1400-1500 on 11795; 1530-1600 on 11795KC. The DX session, "Hullo DXers," is on the air on Saturday at 1230GMT.

POPULAR STATION

A recent survey conducted by the UN DX Internationale, in the United States, shows that the Radio Nederlands transmissions from Hilversum, Holland, have been voted the most popular. This is similar to the recent British poll which placed the Dutch station in the same position. As regards DX sessions, Radio Nederlands again was placed first in this category.

A rundown on the places of the most popular stations, Radio Nederlands 1, BBC London 2, CBC Montreal, Canada 3, Radio Prague, Czechoslovakia 4, Radio Sweden, Stockholm 5, Swiss Broadcasting Corporation, Berne 6, Radio Australia, Melbourne 7, Deutsche Welle, Cologne 8, and Voice of America 9.

The most popular DX Session is DX Jukebox from Radio Nederlands, followed by Radio Sweden, Radio New York, Radio Australia, Radio Lisbon and Radio Budapest.

SEYCHELLES ISLANDS STATION

Information from the Department of Tourism and Information, P.O. Box 92, Mahe, Seychelles Islands, advised Dene Lyneberg, of Wellington, NZ, that they no

CRYSTAL PYE **DIVISION**

Manufacturers of Quartz Crystals for Frequency Control and Crystal Filters for Highly Selective Circuits, Announce:—

NEW LOWER PRICES FOR CLOSE TOLERANCE GOLD PLATED CRYSTALS FOR AMATEUR APPLICATIONS

- 1.8 Mc/s to 14.999 Mc/s ± 0.005% in Style "D" holders, ½in pin spacing. **Amateur net £2/8/6 each including tax.**
- 15 Mc/s to 47.999 Mc/s ± 0.005% in Style "D" holders, ½in pin spacing. **Amateur net £2/10/6 each including tax.**
- 48.0 Mc/s to 61.0 Mc/s ± 0.005% in Style "D" holders, ½in pin spacing. **Amateur net £2/16/3 each including tax.**
- 100 Kc/s ± 0.005% in HC13/U holders, ½in pin spacing* **Amateur net £4/10- each including tax.**
- 1 Mc/s ±0.005% in Style "D" holders, ½in pin spacings* **Amateur net £4/10/- each including tax.**
- 455 Kc/s nominal Crystals for Filter applications in Style "D" or "E" (B7G) holders. **Amateur net £4/10/- each including tax.**

* Specially designed for Crystal Calibrator purposes.

Many other types and tolerances are available from our standard production. Please consult us on your Crystal requirements.

PYE PTY. LTD.
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longer operate on 4990KC with 40 watts as has been the case for some years. The station advises that they moved to the medium wave band on July 20, 1965, to 1336KC. Radio Seychelles will now be beyond reception outside the area of the Seychelles, but the new frequency is giving much better local service than when on short wave. The station did receive some reports when they were heard outside the Seychelles area on 4990KC, according to the Director of Tourism and Publicity, Mr D. O. Mathews.

NEW FRENCH RELAYS

Last month we featured news on plans by many international stations to operate relay bases overseas nearer the target area to which the programs were being directed. Now we learn of the plans of the ORTF in Paris to do likewise. The Office of the Radiodifusion Television Francaise in Paris has announced plans to establish high-powered relay bases in the French Somaliland to serve as a rebroadcast station to cover Africa, the Middle East, and Asia, and to build a further station in New Caledonia to cover the Pacific. In the South American area a station is to be built in French Guiana to rebroadcast the Paris transmissions for the Central and South American listeners.

FLASHES FROM EVERYWHERE

GUINEA Republic has two programs in French from Conakry, the first one is at 2200 to 2400 G.M.T. when using 9650 and 4910KC. The second 0600-0830 is on 6155 and 4910KC. August Balbi in Los Angeles reports this reception and the 0600 transmission should also be heard in the Pacific when interference from Vienna, also on 6155KC, is not too severe.

UNITED STATES station KGEI in
Francisco, which is operated by the
East Broadcasting Company and ca
gospel programs, is using a new
band channel, that of 9715KC.
station is on the air 0200 to 0400 G.
with the service to South America.
grams in English, Spanish and Portug
from KGEI "The Voice of Friends
are also on the air on 15240KC,
to 0200 G.M.T.

TAHITI has made some slight freque
changes for the Papeete station, they
now on 11820KC replacing 11825,
6140KC has been replaced by 6135
The program opens in Tahitian, but
last three hours of transmission is
French.

CONGO station at Leopoldville has
heard in French on 7170KC at 0400
later at 0550. A news bulletin in Eng
is presented, but sometimes the Eng
bulletin is on the air at 0545 instead
0550.

IRAN'S transmission over Radio Tehe
has made a frequency change for
English news bulletin at 2100 G.M.T.
channel of 15115KC has been repla
by 7135KC and 11730KC is used
The Teheran station has been us
7090KC for this transmission, but
higher power on 7135KC gives the be
signal of the two in the 41M band
2100 G.M.T.

NIGERIA over the Lagos station has a n
bulletin in English at 2100 G.M.T. w
four frequencies, 15255, 11915, 9690
7270KC are all carrying the session.
station signs off at 2215 G.M.T. afte
further bulletin of English news. Sig
indicate that 100KW is now used on
four frequencies.

KIGALI is reported to be heard in
relays of the Deutche Welle programs
several readers, the session 1545-1
G.M.T. on 9695KC, 1745-1830 on 17
KC. A German transmission 2000-2
on 11770KC is also reported at good le

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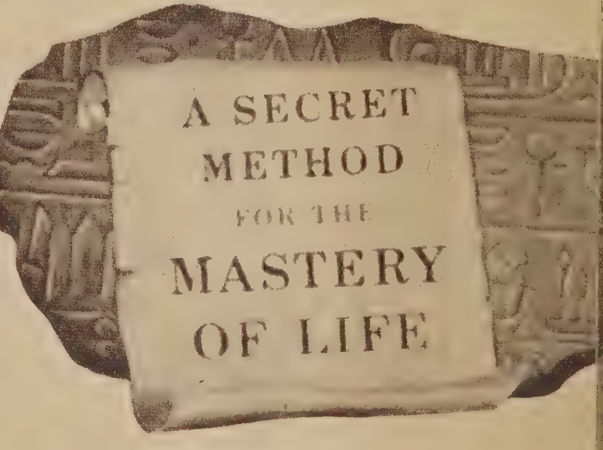

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'ANA Cuba with the transmissions of idio Havana in English to North nerica is now on the air from 0100-00 using 6170KC. The same program on 6135KC for the period 0330-0600 M.T. The signals are best on 6135KC, e other channel suffering from inter-rence from other stations on the same equency.

AEL has been heard in English 0900-00 G.M.T. on Sundays, as reported in previous issue, and news from Europe dicates this transmission, on the air on nday only, is also carried on 9009KC. nese two frequencies are beamed to e Pacific, Africa, and Europe and the insmission continues at 1000 with one ur program in French, from the studios Jerusalem.

NTE CARLO, home of Trans World idio, is now on the air in German 35-0850, 1125-1140 on 7260KC, on Sun-y on 7235; 1930-1955 on 5943KC; onday and Friday 1630-1655 on 5943. ne transmission in English, is daily 0630-45 on 7260KC.

LIN International has been heard by e of our Victorian readers Desmond ingey of Yallourn, who heard the ition at 1200 G.M.T. on 15240KC. The ition at present is giving excellent recep-n in the English transmission with illo DXers on Saturday at 1230 G.M.T. er Radio Berlin International.

IMARK is reported by John Heron of oydon, N.S.W., as being heard on Tues-y, Thursday and Saturday from 0930 1000 G.M.T. in English on 15165KC. ne station has a DX session on Thursday 0950, but is generally blocked by All dia Radio, which also uses this fre-ency and sign on at 0955 ready for e transmission at 1000 G.M.T. from elhi to the Pacific area. The Copenhagen insmission is generally spoilt for the t five minutes of the English broadcast.

DAD is giving good signals at 1030 n-on, using 15400KC. Our reporter John eron of Croydon, N.S.W., states the ogram at the opening of this trans-ission is in Arabic.

ORID has a transmission in Spanish r its listeners in the Philippines, which on the air 1030 to 1240 G.M.T. The ition uses three frequencies for this idio Nacional Espania transmission, 95, 11715 and 15420KC. The program om Madrid in French and Arabic is w 1330-1430, 1500-1700 on 9360KC.

RO has added an additional transmitter om 1800 to 2330 G.M.T., when it is amed to Europe, they use the new annel of 9675KC, as well as the usual annels of 9475 and 11915KC. The three tlets carry a program in English from 30 to 2230 G.M.T.

DIS ABABA in Ethiopia is reported to heard on 1600-1700 on 6185 and 08KC and 1700-2000 on 6185KC cording to the Swiss DX session. This me program of the Voice of Ethiopia Addis Ababa has also been heard on additional frequency of 5056KC, in Amheric language, at 1730, according Bob Padula of Melbourne, Victoria.

ABETHVILLE in the Congo is being ard in Europe on 11864KC at 1815 d 2000 when news in French is given. gnals are strong from this 50KW trans-tter, which according to the station nouncement, is the only frequency in on short wave by Radio Elizabethville present.

TO station HCJB has been noted on 775KC at fair level to 2200 G.M.T. e station has a program in German 2000 and at 2030 carries a service for indanavian listeners. HCJB is also us-15405KC, at the same time, this is other relatively new channel. At 2200 station on 11775KC closes and the gram continues on 15115 and 17895KC Japanese.

RENCO MARQUES station of the lio Club of Mozambique has a session Portuguese beamed to Europe. The program, called "Transmission C," is reported by the Swiss DX Session as being well received in Europe when using 15295KC from 1630 to 2000 G.M.T. The station, according to the announcement, also transmits on the 16M band, but this frequency has not been heard.

HANOI in North Vietnam is reported to have sessions in English as follows: 0500-0515, 1300-1330, 1530-1600 on 9760, 9840, 11640 and 11840KC. Transmissions in French are at 2245-2300, 0415-0430, 1400-1430 on 9840 and 11840KC, according to the World Radio Handbook bulletin.

LISBON'S new transmission for listeners in Europe, "The Voice of the West," in Lisbon Portugal is in French 1945-2015, in English 2015-2045, German 2145-2230 on 6025 and 7130KC. The station announces 7225KC for the 41M channel, but this is actually 7130KC.

CAIRO is using two 16M band frequencies, in the transmissions of the United Arab Republic, according to Ern Suffock, Adelaide, South Australia. One channel, on 1790KC, directs a program to Indonesia at 1400 G.M.T., while on 17920KC there is a session in English at 1400 G.M.T. Cairo also has English at 2130 G.M.T., when using the two frequencies 9475 and 11915KC.

MONACO station Trans World Radio at Monte Carlo is reported to be on the air on a test basis using the new channel of 11980KC. The test has been heard on a Sunday at 1530 G.M.T. Trans World Radio also have a transmission on 11960KC at 1600 when they close after a program in the Russian language. The test on 11980KC included frequent announcements for reports in English.

ADDIS ABABA is reported by the Australian Radio DX Club to be heard on 5056KC with a program in Amheric. The Ethiopian station has been reported with English at 1815 G.M.T. on this frequency, but this transmission does not appear to be of a regular nature.

FRENCH GUIANA station of ORTF in Cayenne, has announced the installation of two additional transmitters. The new frequencies are 3385KC with 4KW, and 4892KC with 1KW which carry the same program as the old frequency of 6170KC which uses 4KW. The transmissions in French are 1015-1130, 1615-0300 and 1830-0400 on Saturday. News in French is at 1030, 2245 and 0100GMT.

PRAGUE is testing for a new transmission in Swahili to commence this month, and the test transmission 1500-1530GMT is on four frequencies. 11990KC gives the best reception, and 15285, 9550 and 7340-KC carry the service also, while the 6055KC frequency is used for the programs for Africans in Europe.

PRAGUE has a new transmission at 1200-GMT when the frequency is 9560KC. The service from Czechoslovakia is at fair level but some interference has been noted from Tokyo on the same frequency. Prague in the transmissions for reception in Europe at 0700GMT on 6055KC is also at fair level. This service is also beamed to the Pacific on 9505, 15285, 15230, 21450KC.

DACCA in East Pakistan, which is seldom reported, has been heard by Ern Suffock of Adelaide SA, when using 17640KC from 1030GMT onwards. Programs are of a local nature, but the signals are blocked before 0945 by Radio Moscow.

BROADCAST BAND NEWS

INDIA has announced that it is to install two broadcast band transmitters of a million watts, in Calcutta and Bombay. The new transmitters are to be brought from the USSR and will help All India Radio to combat the propaganda transmissions from Radio Peking according to the World Publications bulletin.

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HONG KONG Commercial Broadcasting Station now uses three MW frequencies, the Cantonese service is on 1050 and 1170KC and the English program is on 1530KC. These stations are heard in our winter months about 1500GMT.

PHILIPPINES. A new station heard well in New Zealand in late October, has been verified by an airmail letter and gives the details about the station and its operation. The newcomer is DYBB in Cebu operated by the Republic Broadcasting System, and has been heard on 1520KC to close at 1600GMT. The station has the power of 1000W and uses an omnidirectional antenna. DYSS in Cebu is the sister station of DYBB. The key to the network is DZBB in Manila, which is operated by the Republic Broadcasting System from its Quezon studios near Manila on 850KC. The new DYBB was officially opened on October 20, 1965, and the new 1000 watt transmitter is giving much better reception than many Philippine stations of much higher power.

NOTES from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, New Zealand. All times are in Greenwich Mean Time, add 8 hours for Perth, 10 hours for Sydney, and 12 hours for Wellington time. All frequencies in kilocycles.

ALBANIA. A powerful new station which we have observed opening at 1600GMT on 1525KC is now reported to be a new
relay station in Albania which has
built by Communist China to rel
programs into Europe. This long pro
relay station to relay Radio Peking
Europe has been heard widely in E
as well as by us in New Zealand
European report shows the schedu
1600-2100GMT and that the statio
some interference in the European
from Vatican on 1529KC. The s
has been observed opening with
Chinese anthem and then follows a
gram in Russian which is also c
on shortwave by the normal Radio
ing transmitters.

JAPAN. Some weeks ago we heard a
gram of the NHK First Network, b
cast on 530KC to sign off at 1500
This is the first time we have n
use of 530KC by any Asian st
though the frequency has recently
used by Australia, which has three st
on the 530KC channel 2KM, 3UI
6DL. Our verification of the rec
of the NHK program on 530KC
been received. This station is an e
mental broadcaster and will soon b
into regular operation. The letter
that the new station on the freq
is still experimental, and they
appreciate further reports on the
tion at this distance.

The new station has the experin
call JO8AD, and is located at Mc
City, Iwate Prefecture, and has the
of 10,000 watts. The verification
and card came from Yoshimasa
Planning Division, Engineering D
ment, NHK, Toyko.

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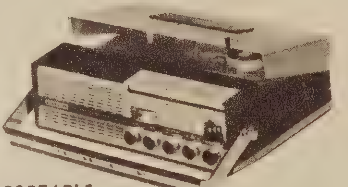

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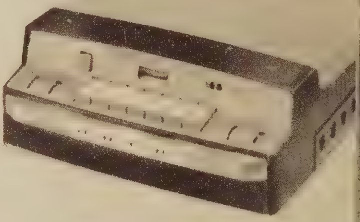

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ANSWERS TO CORRESPONDENTS

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PWM AMPLIFIERS

Mc. (Atherton, Qld.) refers to an advertisment regarding a Pulse Width Modulated amplifier and asks whethe we would review it in our magazine.

ough we have seen the advertisements which you refer, we have not so far approached by the people concerned eview this equipment. For the present, efore, we regret we cannot offer much . However, if you are interested in principle of operation of Pulse Width dulated amplifiers we did discuss this the Answer Man pages of the July edition.

BEAT PHENOMENA

(Nth. Fitzroy, Vic.), is not at all happy about our reference, in an article on musical scales and tuning, to a possible connection between musical beats and non-linear effects. He feels that non-linearity is not a pre-requisite to beats being heard.

is quite a classic topic for argument because we knew it to be so, we tried acknowledge the different points of without specifically taking sides. It irrelevant, anyway, to the mainstream ur topic. However, the fact that there is nuch argument might suggest that it be dismissed quite as lightly as you ld be inclined to do. Much of it stems rently from the idea that, while the ntaneous algebraic sum of multiple ls can be plotted on graph paper, n on a CRO or rendered visible al-tively as movement of a loudspeaker , it does not follow that the ear can rve the effect quite as readily. If it is ned that the ear mechanism does not a response into the very low fre-cy regions entailed by musical beat omena, the question arises as to how ear really hears the beats. Some think rms of a rate of amplitude variation; attach weight to normal heterodyne y and seek to find a parallel in the hearing function; still others like to a foot in both camps. If you can put hands on a copy of "Wireless World" November 1952, you may be interested hat "Cathode-Ray" had to say on the ct.

TRANSMITTERS, FM TUNER

. (Cronulla, N.S.W.), writes in support of a tuner for receiving the FM sound of TV stations. He would also like to ee us describe a small transmitter to roadcast about 600 yards, which could e used in conjunction with a tape ecorder for outdoor use.

k you, J.W., for your remarks and rt for an FM tuner to receive TV . As we have stated previously, we nave to get more inquiries before we pend the time on this project. How- we are keeping a close watch on this and we will review the position from to time. We have had a few requests "wireless microphone" type of trans-/receiver combination, but to date we have not had a chance to produce anything of a practical nature. We may take another look at the idea in the future and, in the meantime, you may care to consult the P.M.G. authorities concerning the various channels which are available for this kind of service, and the type of equipment which they would approve.

RADIO SHACKS

J. K. (Ryde, N.S.W.), says that many things conspire to deter the activities of radio experimenters in Australia. He believes that prices are too high, as also the sales tax on radio components. He suggests further that local Government authorities frown on radio "shacks" separate from the house and on large aerial systems.

Thank you for your observations, which add to those in recent "Forum" instalments. Your complaint about radio shacks, aerials and local government authorities is one that has not recently been raised. Are these authorities generally as restrictive as those that you have experienced or do amateurs erect shacks and aerials first and ask afterwards? Other readers may care to express themselves on this one.

MULTI-CHANNEL MIXER

G. A. C. (Chadstone, Vic.), asks if we would consider the description of a fairly elaborate audio mixing unit, preferably transistorised and incorporating VU meters, magnetic pickup input and both high and low impedance microphone inputs. It would be desirable, he adds, to have the unit arranged so that it could be used for either stereo or mono, and to use "straight-line" mixing controls. Finally, he would like the "Answer Man" to explain the operation and purpose of balanced microphone lines and input circuits.

As you have no doubt discovered in this issue, G.A.C., we have done more than consider the description of a transistorised mixer. Although the mixer we have developed does not employ "straight-line" fading controls, these could certainly be used if desired and available. The same applies to your request for VU meters. Although the metering circuitry to be described gives metering which closely approximates standard VU meters, it uses standard movements for economy. However, there is no reason why special movements should not be used if desired and available, as the article explains. Your query regarding the operation and purpose of balanced and unbalanced lines and input circuitry has been passed to the "Answer Man," who will try to answer it in the near future.

STROBEFLASH

R. M. (Belair, S.A.) says that he would like very much to see us describe an electronic strobe unit capable of repeating flashes at a rate of between 1 and 40 times per second. He thinks it should have interesting possibilities for action photographic studies.

No, we certainly have not described a unit along these lines and we are not in a position to offer immediate help. We will make a note of your suggestion, however, and follow it up if the opportunity occurs. How such a device would compare with commercial strobe units would be one of the important considerations, since there is little point in getting excited about something which you can buy cheaper as an imported item than you can build. This is true, for example, of ordinary electronic flash units.

WANTS VALVE RECEIVERS

N. H. (Sth. Otago, N.Z.), says that while "ELECTRONICS Australia" has advanced with the times, it has also drawn away from the needs of younger readers. He would like to see more valve projects, suitable for construction from scrapped radio parts. He would also like to see the technical standard of more elementary articles like "Answer Man" brought down closer to the technical level of beginners.

We are by no means unaware of the problem, as will be apparent from our editorial in the July issue. The fact is that electronics has taken on such a spread of interest that we are compelled to spread our available coverage more thinly over a much wider range of subjects. We are very much alive to the needs of beginners but this does not mean that we can devote more than a fair share of the available space to their interests. The same remark would apply to any other reader group. Your letter has made a point, however, and while it can't have the effect of triggering a whole series of beginners' articles, it helps to ensure that we don't overlook these younger readers.

"ELECTRONICS Australia" INFORMATION SERVICE

TO assist readers, "ELECTRONICS Australia" conducts a technical information service. Conditions governing this service are set out below:—

(1) Address letters to: Assistant Editor, "ELECTRONICS Australia," Box 2728, G.P.O., Sydney.

(2) Requests for copies of circuits or technical information requiring a postal reply must be accompanied by postal note or stamps to the value of $0-20 (2/-). Queries not accompanied by a fee will be answered in rotation on these pages.

(3) For the $0-20 fee, we will supply circuit data, as available, from our files. The amount of data available varies, but in no case can it include information additional to that already published in the magazine For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for circuits will be answered more speedily if they are not complicated by questions requiring the attention of technical personnel. Where articles are not on file we can usually provide a photostat copy at $0-20 PER PAGE.

(4) The information service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits. Please note that the inclusion of an extra fee does NOT entitle correspondents to special considerations.

(5) The editor reserves the right to return fees or to limit the scope of an individual reply when it is felt that a partial answer will be better than none at all.

(6) In addition to the above service, chassis blueprints are available for most of our projects showing the position of holes and cutouts for metal-working, but containing no details of wiring. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost $0-50 (5/-) each. Original photographs of most projects are also available, from $0-50 for a 6in x 8in glossy print, postage $0-08 (9d).

(7) "ELECTRONICS Australia" does not deal in radio components nor will we debate the relative merits of competitive products. Prices and specifications should be obtained from advertisers.

(8) Technical queries are not answered by telephone.

(9) We have no file of circuits for commercial radio or TV sets, etc.

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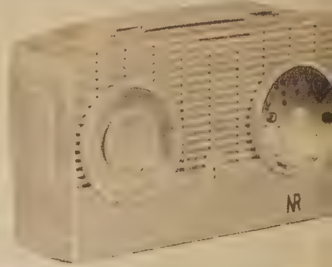

The complete kit of parts for the transistor six includes six transistors, printed circuit board, coil kit, 4in speaker, Ferguson driver and output transformers, heavy duty battery and all necessary parts to complete the set with full instructions. **Set is housed in attractive plastic case as illustrated.**

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TYPE	EQUIVALENT		
XA101	OC45	R.F. Transistor	5/6 ea.
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XB103	OC75	AUDIO general purpose	7/6 ea.
MTC71	OC71	General Purpose	

Ducon type SFT 123 equiv. OC74 .. .. 7/6 ea.
Available in matched pairs at .. .. 15/ pair
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A.W.A. 23" E.H.T. transformers and 23" 110 deg. deflection yokes. New manufacturers stock E.H.T. units 50/-. Deflection yokes 50/-. Post free.

NEW VALVES AT BARGAIN PRICES

1A7GT	9/6	3S4	10/	6J5	7/6	6SN7GT	9/6	1L56	9/6
1C7G	3/	5Y3GT	12/6	6K7G	4/6	6SS7 equiv. 6SK7	8/6	12A6	5/
1D8GT	9/6	5V4G	10/	6K8G	6/9	6U7G	4/6	12SK7	5/
1K5G	4/	6B8	10/	6Q7G equiv. 6B6G	10/	6X5GT	7/6	12SK8	5/
1K7G	4/	6C8G	5/	6SA7GT	9/6	7C7	3/6	12SH7	5/
1M5G	4/	6F6	10/	6SH7	5/6	12AU7	10/	866	15/
1P5G	2/6	6H6	3/6	6SJ7	9/6	12AT7	10/	954	2/6
1Q5G	2/6							955	2/6
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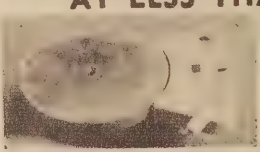

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STEREO £5/17/6

Post and Packing, N.S.W., 7/6.
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3300 R.P.M. can be supplied with or without 4-speed reduction mechanism. Size 3¼" x 2¾ x 3½, including spindle.

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0—250v	0—50v	0—1MA	
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New 9 x 6 speakers in case with volume control, 75/. Post: Interstate, 5/6; N.S.W., 4/.

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60mA prim.: 240v with 230v tapping Sec. 285 x 285 with 6.3v filament winding. 60mA, 25/. Plus postage: N.S.W., 3/6; Interstate, 5/3.

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60mA H.T. Chokes, 7/6. Post.: 2/.

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A MUST FOR QUICK TROUBLE SHOOT

Using TWO Transistors, complete with ins tion sheet and battery. Post

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3½in Per Mag Tweeter with Cross Over Condenser	
6in x 9in Per Mag Hvy. dty. 15 ohm	
8in per Mag	
10in per Mag	
12in per Mag	
12in per Mag 20 watt	

Post and Pack, 5/ N.S.W.; 7/6 Interstate.

12in Per Mag .. .. 67/6, Post and Packing 7/6 N.S.W., 10/ Interstate.

Speaker Transformers for above 6T, 5T or 7T 10/.

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RESISTORS, CONDENSERS AND POTENTIOMETERS

We have purchased the resistor and condenser stock of manufacturers including S.T.C. and Stromberg-Carlson who have ceased the maufacture of television and radio receivers and can offer same at less than 25 per cent of list price.

The resistors are mainly I.R.C. and Morganite in values from 200 ohm. to 5 meg in ½, 1 and 2 watt ratings and include some wire wound resistors. List price, £4/10/ per 100. **Our Price, 20/ per 100.** Post and packing, 2/6 extra.

The condensers are in most popular makes and include mica, ceramic, paper and electrolytic in standard values. List price, £5/10/ per 100. **Our Price, 20/- per 100.** Post and packing, 3/6 extra.

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FREE For a limited period with each lot of resistors, condensers or potentiometers purchased we will supply free: One New Valve Type 6U7G or IT4 as advertised on this page.

New English Miniature 11 x 1 Switches

These new miniature eleven-position single-bank switches are 1" diam. with ¼" spindle, they have silver-plated contacts and high quality insulation suitable for H.F. use.

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These 240 v. a.c. or d.c. motors are 1/8 H.P. with a speed of 7,000 R.P.M. and are ideal for small drills, grinders, etc. Dimensions, 5½in x 3½in, with 5/16in spindle 37/6
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LAYER F.O.R. £8/15/0

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4-SPEED F.O.R. £10/15/0

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10 pole 2-way silver plated contacts 3/9

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**240V A.C. operated, 6 band 120KC to 390 Megs
Provision for crystal.
Post N.S.W. 7/6; Interstate 12/6.** £15

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**New Selenium Rectifiers, 6 or 12 volt, at 4 amp., 37/6. Post, N.S.W., 2/; Interstate, 2/. Transformer for above rectifier tapped for 6 or 12 volt, with circuit for charger, 47/6. Post, N.S.W., 7/6; Interstate, 10/.
As above, 6 or 12 v., at 2 amp., 27/6. Post, N.S.W., 3/6; Interstate, 4/6. Transformer for above, 37/6. Post, N.S.W., 3/6; Interstate, 4/6.**

NEW 240V. A.C. MOTORS

These small motors, size 3in x 3in x 3½in, are 1-12 h.p. but are only suitable for intermittent use. 29/6. Post N.S.W. 3/6; Interstate 5/.

THE NEW COLLARO 3-SPEED TAPE-DECKS 2 & 4 TRACK

The ideal deck for the home constructor, as amplifier and all controls can be mounted on deck.

3-speed 1⅞, 3¾, 7½. ● Pause control. ● Takes 7in spools. Simplified controls. 4 Track, £24; 2 Track £22. OSC Coils, 15/.

NEW B.S.R. TAPE DECKS

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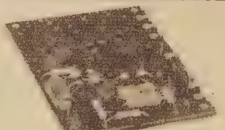

Using 3 silicon transistors as featured in October, Electronics Australia complete with kit of parts including transistors mono **£3/15/**, stereo **£6/10/**. 240 power supply for above **£3/10/**.

NEW 17 & 25 WATT P.A. AMPLIFIERS

**WATT £26/17/6
WATT £21/17/6**
Post Extra on 15 Watt N.S.W., 10/; Interstate, 15/.
25 Watt by Rail or Air. Too Heavy, for Post.

The 25 Watt Amplifier uses 5 valves plus 2 rectifiers including two EF86 low noise valves as microphone preamplifier and two EL34 valves Ferguson push-pull output.

All amplifiers are fitted with Ferguson output transformers with voice coil tappings of 2 to 15 ohms. The 25 watt amplifier can be supplied with line output transformer tapped from 100 to 600 ohms if required at 20/ extra.

Inputs provided for microphone, pick-up, and radio with mixing facilities and tone control.

The 15 watt is as above but using two 6BQ5 valves in push-pull output.

12in speaker for above (10 watt) 67/6

Crystal Microphones for amplifier 47/6

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Also included is the manufacturer of the transistor, **NPN** or **PNP** polarities, whether the type is germanium or silicon, and a terminal guide for each type listed. Accompanying text sections explain why transistor substitution is possible, when substitution is appropriate and when it is not, how to choose substitutes, and the precautions that should be observed when a replacement is used. A semi-conductor diode cross-reference directory completes the comprehensive coverage.

The information in this handbook is applicable for use by everyone concerned with transistor replacement—be it military, industrial, commercial, or home entertainment devices.

(Cat. Code No. SSH-6).
128 pages. December. **21/6.**

POCKET DICTIONARY OF COMPUTER TERMS
by the Howard W. Sams Technical Staff

This new books offers in a compact and convenient-sized volume over 850 authoritative and up-to-date definitions for terms, words, abbreviations and phrases used in computer technology. Included are terms for all types of general and special purpose computers—analog, digital and hybrid. Students, programmers, technicians, engineers and others will find this dictionary an invaluable reference source.

(Cat. Code No. DCT-1.)
96 pages. December.

FUNDAMENTALS OF MODERN SEMI-CONDUCTORS
by Barron Kemp & R. H. McDonald

Explains the intricacies of the various types of semiconductors being used in today's electronic circuitry. For the individual who possesses some knowledge of transistor technology, this book will prove invaluable—not only as a source of learning, but also as a ready source of reference material. Technicials, engineers, teachers and students will find the material presented in easy-to-understand language with an absolute minimum of mathematics and formulas.

In addition to a more detailed study of basic semiconductor electronics, this book includes enough background knowledge on transistor fundamentals to help the reader understand the theory of new devices.

(Cat. Code No. FSK-1.)
41/.

SOLID-STATE POWER SUPPLIES AND CONVERTERS
by Allan Lytel

This handy reference book is a compilation of transistorised and solid-state circuits, including circuits for power supplies, converters, inverters, voltage regulators and electronic ripple filters. Some of the circuits use transistors, others use sillicon rectifiers, and a few use both. This is an easy-to-use source of information on the operation and application of solid-state power supplies.

(Cat. Code No. PSL-1.)
112 pages. October. **34/.**

TRANSISTOR TRANSMITTERS FOR THE AMATEUR
by Donald L. Stoner W6TNS

Complete construction details and operating instructions for a variety of practical projects and transistorised devices.

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by Electronic Teaching Laboratories Code No. ERH-1).

ELECTRONIC TEST INSTRUMENT HANDB
by Joseph A. Risse (Cat. Code No. ET

RECENTLY PUBLISHED

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by the Howard W. Sams Engineering St

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A carefully graded selection of exercises designed to make learning the Morse Code as simple as possible. **2/11**

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The most acurate and comprehensive list of Amateur Radio fixed and mobile stations in the United Kingdom. Also lists stations in the Republic of Ireland. **9/11.**

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Contains the commercial equivalents of all the CV numbered valves, cathode ray tubes and semiconductors useful to the amateur. Also lists British Army, Royal Navy, Royal Air Force and U.S. Signal Corps valves. Pocket size. **5/6.**

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TECHNICAL BOOKS AND PUBLICATIONS

ICAL INSTRUMENTS AND AUDIO Y G. A. Briggs. Hard cover, 238 pages, ½ x 5 inches. Published by Wharfe- ale Wireless Works Ltd., Bradford, ngland. Available from technical book- ellers, price 48/6 posted. ($4.85.)

h the release of this sixteenth book the Briggs-Wharfedale combination, prompted to speculate whether it is a f a loudspeaker manufacturer sponsor- ooks or the reverse. Perhaps we should k that it—or they—manage to do both rather well!

this book, G. A. Briggs discusses al sources of the sound which his eakers are called upon to handle—the musical instruments. I use the word ss" with the idea that it may convey nes of informality—a kind of chatting nt.

cover a subject like this in 238 pages, icial textbook would need to be sys- ic, concise and occupied with detailed, er dry, data.

this isn't the spirit of Briggs. He es through his chosen subject, picks he things that interest him—humour ll—and sets them down, on the as- ion that they will probably interest people. And he isn't far wrong, be- it's difficult to scan his book without caught up with what he has to say.

contents of the book are indicated y a run-down of the chapter headings: al Principles—Various Sounds — Var- Instruments — Characteristics of In- ents — Formants — Distortion In s — Distortion In Reproduction — s — Electronic Organs — Pianos — g — Music In Schools — Conclus- Appendix, Index.

hin the ambit of these chapter head- s a lot of interesting and informative g for those who may want to build eir background on the subject in the painless possible fashion. You might across a few points that you would debate with the worthy G. A. B. — w I did—but discussions are always is, whether by word of mouth or page nt.

d, technical, sitting-up-in-bed reading!

copy came from McGill's Authorised gency, 183-185 Elizabeth Street, urne, C1. (W.N.W.).

* * *

TRIC MODEL CAR RACING by . J. Laidlaw-Dickson. Cloth bound, 24 pages, 8½x5½ inches. Published y Museum Press Ltd., London. Avail- ble from booksellers, Australian price 2/6d. ($3.25).

del car racing has emerged in the ew years as a serious hobby, and w advanced to the stage where it is ious challenger for the pre-eminent n that model railways have held any decades. Evidence of the deep interest in this hobby is to be found increasing number of books appear- n the subject. The author of the under review is also the editor of a magazine entitled "Model Cars", is devoted entirely to the subject, should be able to present the subject uthority. In fact, Mr Laidlaw-Dickson very comprehensively with the sub- nd his narrative is illumined through- ith the light of the true enthusiast subject.

common with most other hobby-type equipment, model car racing sets, and the accoutrements which the enthusiast likes to have for the sake of realism, are expensive. For this reason, one feels that the real value of this book for the modeller lies in the chapters which tell how to make model cars and tracks from toys and material available cheaply. It is doubtful that this is quite so delightfully easy as the author suggests, and it is to be hoped, for the sake of the unskilled modellist who might be tempted to try his hand at construction, that it is not too much harder than is represented here.

Appendices contain information about competition rules of the Electric Car Racing Association, international car racing colours, and electro-plating. (H.A.T.)

* * *

ELECTRONS AND WAVES by John R. Pierce. Soft cover, 226 pages, 7¼x4½ inches. Published by Heinemann Educational Books Ltd., London. Available from booksellers, price 9/6d. ($.95.)

This excellent little book contains a wealth of information on basic radio theory, and first year technical students will find it a useful summary of elementary principles. Mr Pierce assumes that his readers have acquired the necessary background of mathematics and physics before tackling the subject of radio, so this book is for the serious student, not for the dabbler.

The first chapters are concerned with the laws of physics that govern the motions of particles and waves, then a whole chapter is devoted to the important equations of James Clerk Maxwell, the Scottish genius who discovered the laws which are fundamental to the science of radio transmission. The final chapters are concerned with transformer theory, valve amplification, travelling wave tubes, and transistors. In the preface, the publishers promise a second volume for more advanced study. (H.A.T.)

* * *

HI-FI AND TAPE RECORDING GUIDE, edited by Keith Winser. Soft covers, 132 pages, size 9½ x 5¾ inches. Published by Keith Winser, 351 Elizabeth Street, Melbourne. Available from booksellers, price 10/ ($1.00).

This publication contains a good deal of information of a non-technical kind for the benefit of the high fidelity enthusiast whose technical knowledge does not extend beyond the ability to recognise that a thin black disc with grooves is a gramophone record. It does a good job of explaining some of the complexities of audio equipment in non-technical terms, and has the advantage, as far as the Australian reader is concerned, that it deals with local conditions, and that the equipment it describes is all available here.

It is an annual publication, and the current issue is the fourth. Much of the material it contains has already appeared in past editions, but on the other hand there is also a considerable amount of new material this year, an innovation being a section on Australian music. More space has also been given to tape recording than in previous issues. (H.A.T.)

* * *

MULLARD OUTLOOK for September-October has circuit and constructional details for a transistorised stereo pre-amplifier suitable for use with a 5W amplifier described in an earlier issue of the magazine; a list of Australian television channels showing stations on each channel and operating frequencies; technical data about a new range of silicon planar transistors and suggested circuit applications; Part 3 of an article about micro-wave cooking; and an article for servicemen dealing with customer relations. Shorter items deal with an electronic tachometer, matching and equalisation of piezo-electric pickups, and new products reviews. (Mullard-Australia Pty. Ltd., 35-43 Clarence St., Sydney.)

RADIOTRONICS issue of December contains the following: Electronic Heat Controls for Appliances and Domestic Heating; Low Level R.F. Amplifier Circuit Design: Electronic Technology in Medicine. Under the heading "Important Announcement" the magazine carries a notification that no new annual subscriptions are being accepted, and that from January 1966 "Radiotronics" will be available quarterly at a cost of 5/ ($0.50) a copy from the Sales Dept., Amalgamated Wireless Valve Co. Pty. Ltd., Private Mail Bag, Ermington, N.S.W.

MEASUREMENT NEWS, published in the U.S.A. by Hewlett Packard, has information about the following products: Model 5060A Cesium Beam Frequency Standard; Model 6832A continuously variable (±20V DC) Power Supply/Amplifier with zener controlled line, load regulation of .02% +5mV and ripple down to 2mV RMS;

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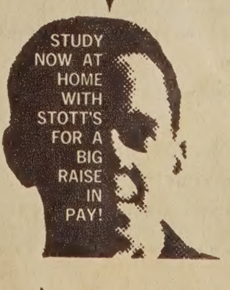

Model 537A Coaxial Frequency Meter for 3.7-12.4GC; Model 8875A Differential Amplifier, DC to 75KC, 1-1000 gain; HP5245L Counter with Model 5252A Prescaler; Model 7001A X-Y recorder for accurate plots of low-level DC signals; Model 414A Autovoltmeter, a digital instrument with automatic range and polarity selection. Hewlett Packard are represented in Australia by Sample Electronics (Vic.) Pty. Ltd., 9-11 Cremorne Street, Richmond, E.1, Vic.

STC COMPONENTS AND EQUIPMENT REVIEW for December, 1965, describes an Italian-made HF radio receiver, Type FRX/SB3, available from STC, Sydney; the Type 2050-A thyratron, which is a four-element gas filled thyratron for relay and grid-controlled rectifier service; a new 60kW RF power tetrode available with forced air cooling (Type 4JC/300J) or vapour cooling (4ZC/300J); the QLD and QLZ series of transverse flow blowers; a new range of low-cost solid tantalum capacitors; radio relay equipment Type ML5, frequency band 403 to 530MC and base band 6 to 108KC; ITT Intermetall silicon PNP transistors; and Type 25 precision miniature DC relay. (Industrial Products Division, STC, Moorebank Avenue, Liverpool, N.S.W.)

STANDARDS ASSOCIATION OF AUSTRALIA has announced the issue of the following new Standards:

Australian Standard C354, Power Transformers for Telecommunication and Electronic Equipment. This has been prepared by the association's Electronics and Telecommunications Committee for the ance of manufacturers and users of transformers, and interests concerned the testing of such equipment, ar establish the mechanical, electrical, climatic properties of the transforme lays down requirements covering clas tion and rating of the transformers includes an extensive series of mecha electrical and climatic tests. Price i ($1.20) a copy, plus handling cha

Australian Standard C302, Type Enclosures for Electrical Equipment. is concerned with enclosures commonly used for protection of ment up to 660V, and gives defin according to purpose and identifi letters allotted for marking, and sp a basic requirement by which the effe ness of each enclosure can be ass Protection for personnel and equipmen also covered. Price 10/9 ($1.08) handling charge.

Australian Standard C358, Dust-excl Ignition-proof Enclosures for Elec Equipment. This Standard has been pared by the association's Committe Electrical Equipment in Hazardous tions for use in conjunction with the Wiring Rules, and for the guidanc users, manufacturers and statutory au ties concerned with the operation of trical equipment in dust-laden air in there is risk of fire or explosion. A prehensive table sets out characteristi combustible industrial dusts. Price ($1.08) plus handling charge.

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E.A. Feb. 66

ROAD SAFETY

Continued from Page 14.

in lane, on a limited-access road that only properly-equipped cars enter (no cyclists, pedestrians, str animals or even fallen trees!), they may only enter and leave at tain points. (Arrival at such points in some way be signalled to each

(The second part of this article, presented next month, deals with authors' suggestion for an electron equipped car which, it is claimed, provide a very high order of safety out the need for specially constr highways, buried cables, or ro electronic equipment.

While a somewhat controversial ject we are presenting the descripti the hope that it will stimulate in and discussion in this very vital su —Editor.)

REFERENCES:

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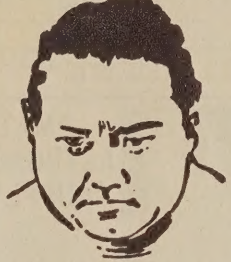

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